United States Court of Appeals

for the Second Circuit

EXHIBITS

ORIGINAL

75-7629

B

P/S

United States Court of Appeals
For the Second Circuit

TUBECO, INC.,

Plaintiff-Appellant,

v.

CRIPPEN PIPE FABRICATION CORPORATION
and HENRY O. CRIPPEN,

Defendants-Appellees.

On Appeal From The United States District Court For The Eastern District Of New York

EXHIBITS

HOPGOOD, CALIMAFDE, KALIL,
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Telephone: (212) 447-5358

INDEX TO EXHIBITS

ICBO NEWSLETTER

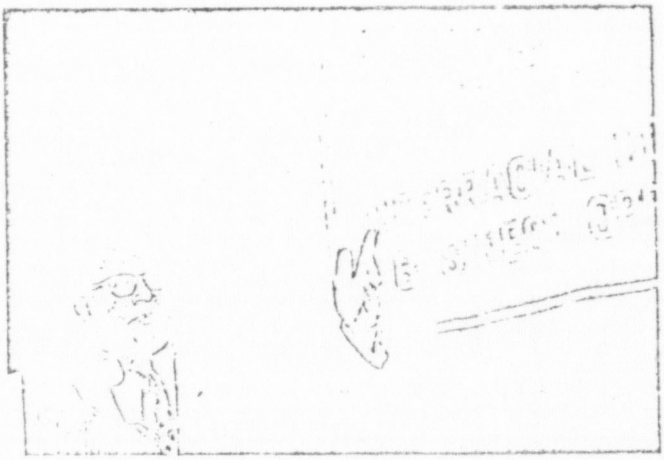
INTERRACIAL COUNCIL FOR BUSINESS OPPORTUNITY

NATIONAL OFFICE — 470 PARK AVENUE SOUTH • NEW YORK, N.Y. 10016 • SUITE 300 • (212) 889-0880

FALL 1972

NEW YORK, NEW YORK

Antony Mason (R), Vice President of Minority Equity Capital Company, ICBO's MESBIC, presents Henry O. Crippen, President of the Crippen Pipe Fabrication Corporation, with a check for $75,000 for stock in Crippen's new company. The investment was part of a $1.3 million financial package.



Darwin W. Bolden, National Executive Director—ICBO

CRIPPEN PIPE FABRICATION CORPORATION BEGINS BUSINESS

On October 31st, the Crippen Pipe Fabrication Corporation, the first in this industry to be owned by a black man, formally began business with the signing of a lease with The Commerce Labor Industry Corporation of Kings, primary lessor of New York's Brooklyn Navy Yard and the finalizing of agreements with a consortium of banks and private investment companies for $1.3 million in financing. The business venture was assisted, at its outset, by The Interracial Council For Business Opportunity (ICBO).

Henry O. Crippen, President of the new corporation, came to ICBO with his newly acquired patent for a special pipe bending and fabrication process. ICBO gave him free office space, found him partners, expertise and capital to start his business from scratch. ICBO's Minority Equity Capital Company (MECCO), a minority business investment company, became an initial investor in this venture and helped secure additional investment and loan financing from The Equitable Life Community Enterprises Corporation; First National City Bank Capital Corporation; Prudential Minority Enterprises, Inc., The Bedford Stuyvesant Restoration Corporation and Development and Service Corporation; Chase Manhattan Bank;

Continued on Page 3

BOLDEN RESIGNS AS NATIONAL EXECUTIVE DIRECTOR

Darwin W. Bolden, who has been National Executive Director of ICBO for the last four and a half years, submitted his resignation to the ICBO National Board of Directors, effective December 15th.

In his resignation statement, Bolden said:

"I have always felt and have expressed frequently to my associates my feeling that the heads of non-profit "cause" organizations like ICBO, should not stay longer than five years with these organizations.

There is a need to recharge these organizations with new thoughts, new leadership and new directions. My departure to take over the Presidency of the Pan African Corporation, a new African business development and promotion firm, gives me the opportunity to fulfill a lifelong ambition to return to my homeland and to make a personal contribution to the growth and development of my people.

I leave ICBO still in a period of challenge. There are many things which, although we have begun them, have not been completely achieved.

ICBO must continue the process of creating strong and enduring linkages with other Black and minority organizations which have

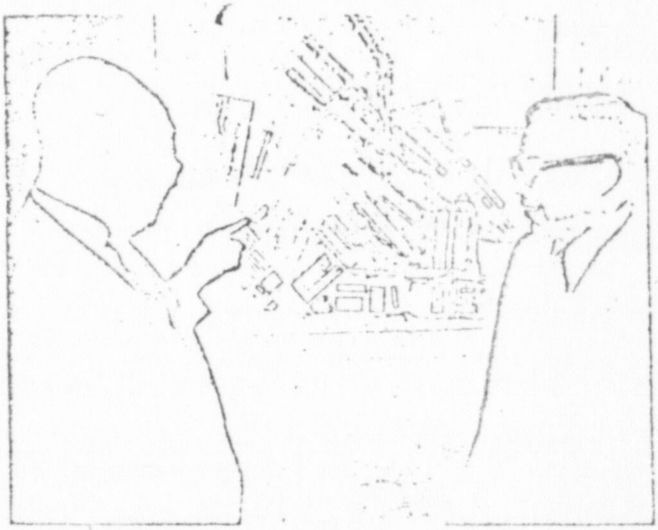
Continued on Page 3

...tinued from Page 1

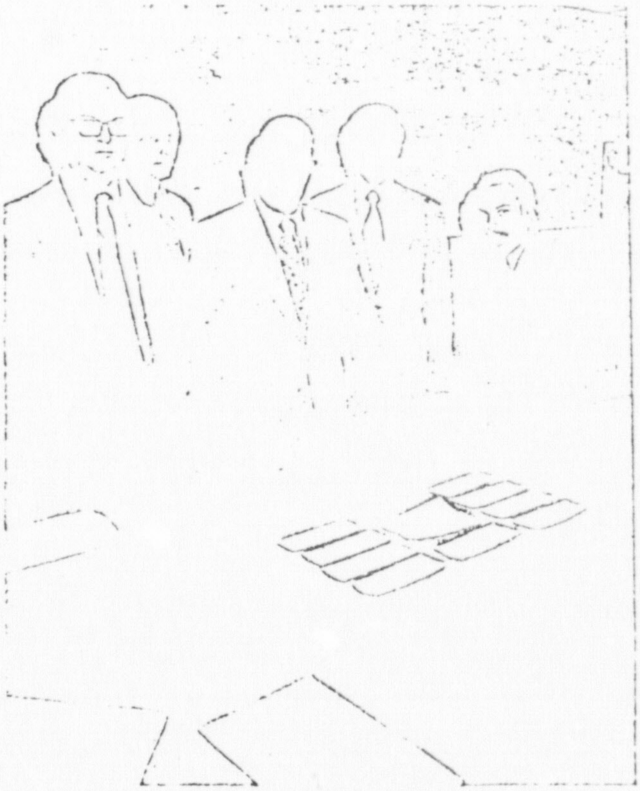
and The Morgan Guaranty Trust Company. The Federal Economic Development Administration also approved a $300,000 loan to the ...mpany

After acquiring his new plant space, and financing, Crippen stated: "We will now be able to supply large fabricated piping assemblies as are used in utility, power stations, chemical plants and oil refineries. Our new corporation will start business with firm sales commitments from the Consolidated Edison Company; Combustion Engineering; Foster, Wheeler Corporation, Riley Stoker Corporation; The Lummus Company; Allegheny Power Corporation; General Electric; and the Mobil Oil Company."

Darwin W. Bolden, National Executive Director of the Interracial Council For Business Opportunity, stated that "The Crippen Pipe Fabrication Corporation is one of the most significant Black owned business ventures assisted by ICBO–we actually helped build a company from the ground up for this very capable man and his ideas. The success of the Crippen venture shows how ICBO, as a catalytic agent, can bring together capital, contacts, management techniques, and sales commitments, which can assist more Blacks and other minorities enter the American economic mainstream through the ownership of their own businesses."



Henry O. Crippen (R), President and Bruce Wallace (L), Vice President & General Manager, Crippen Pipe Fabrication Corporation, point out on a map of The Brooklyn Navy Yard the site of their new plant. Their company is one of several minority owned companies which have moved into the Navy Yard as part of a long ranged Program to uplift the general economic conditions of that area of New York City.



...ry O. Crippen (Center) President of the Crippen Pipe Fabrication Corporation thanks some of his financial backers for their generous checks which now allow him to begin business. With him are (L to R) Stephen Tuttle, Prudential Minority Enterprises, Inc., Joseph G. Solari, Bedford-Stuyvesant Restoration Corporation; Crippen; Howard Mackey, The Equitable Life Community Enterprises Corporation; and Antony Mason, Minority Equity Capital Company—Interracial Council For Business Opportunity.

Continued from Page 1

the capability of effectively assisting minority business development. Only when we are united and working together in a spirit of mutual cooperation will our common goal of equal opportunity for all minorities be realized.

We have not yet completed the process of taking existing minority businesses to the next level of business activity. The whole field of minority business development is still "mom & pop" oriented. We still need to upgrade the focus of middle-level business activities. This is the only way we are going to be able to make a substantial contribution to the growth and development of an economically viable minority community.

I want to take this opportunity to express my sincerest appreciation to the National Board of Directors, all our local council boards of directors and to ICBO's dedicated staff and volunteer consultants.

Their combined efforts, supported by the generous contributions of hundreds of corporations, foundations, government agencies and individuals, have enabled ICBO to really become the foremost interracially directed and staffed voluntary organization in the minority business development field.

I will continue to look forward to seeing even greater accomplishments by this great organization."

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PDX-4

CRIPPEN PIPE FABRICATION CORPORATIO

Building 269, Brooklyn Navy Yard
Brooklyn, New York 11205
Telephone 212-858-2900

CRIPPEN PIPE FABRICATION CORPORATION

Crippen Pipe Fabrication Corporation is a newly established minority company primarily concerned with the bending and welding of fabricated pipe assemblies to the most exacting specifications.

The Crippen Patented Hot Pipe Bending Apparatus quickly produces pipe bends that meet the increasingly critical criteria for bends, minimizing thinning, flattening, and wrinkling

Welding and other operations are carried out by experienced craftsmen trained to the most exacting requirements.

This is an invitation to visit, a welcome, and a guide to the Crippen plant, which is located in the former Brooklyn Navy Yard, as well as a list of facilities available.

Very truly yours,

Henry O. Crippen

Henry O. Crippen
President

PIPE BENDING AND FABRICATION

CRIPPEN PIPE FABRICATION CORPORATION

LIST OF FACILITIES

MANUFACTURING PLANT

Production Building	25,000 Square Feet
Inspection and Storage Building	30,000 Square Feet
Furnace Building	1,500 Square Feet
Service Building	10,000 Square Feet
Outside Storage	Space Available As Required

INSPECTION BUILDING (No. 268)

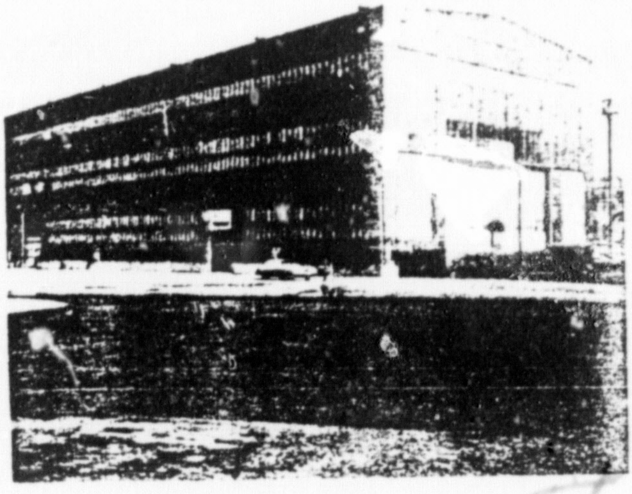
One Main Inspection and Storage Building served by
Various Jib Cranes with Electrical Hoists
1- Radiograph Cell
1- Dark Room with Complete Facilities
1- Ultrasonic Tester - Krautkraemer Model K
1- Optical Pyrometer
1- Brush Surface Roughness Measuring Unit
Magnaflux Inspection Equipment
Dye Penetrant Inspection Equipment
Hydrostatic Testing Equipment
1- Railroad Siding into Inspection Building

PRODUCTION BUILDING (No. 269)

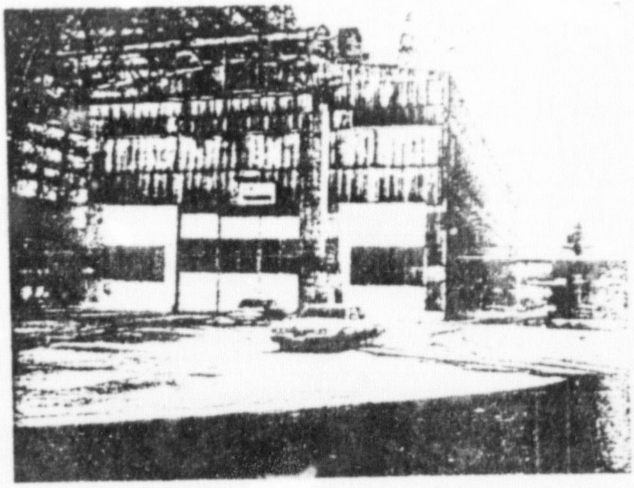
One Main Production Building served by
2- 20 Ton Capacity Bridge Cranes
2- 5 Ton Capacity-35'Reach Jib Cranes with Electrical Hoists
Various 2 and 3 Ton Capacity Jib Cranes with Electrical Hoists
1- 10 Ton Capacity Mobile Hydraulic Crane
1- Railroad Siding into Production Building

FURNACE BUILDING (No. 71)

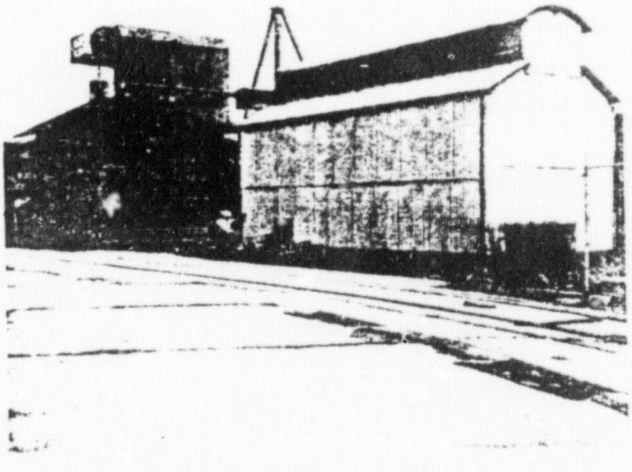
One Car Type Furnace served by
1- 5 Ton Capacity-22'Reach Jib Crane with Electrical Hoist
1- Quench Tank
1- Mobile Weather Protection Shed



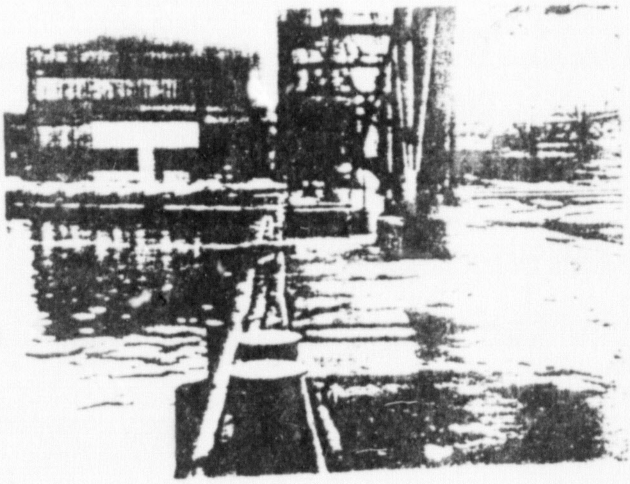
FABRICATION SHOP AND OFFICE
Building 269 - West Corner
(35,000 Square Feet)



INSPECTION AND SHIPPING BUILDING
Building 268 - Southeast Corner
(30,000 Square Feet)



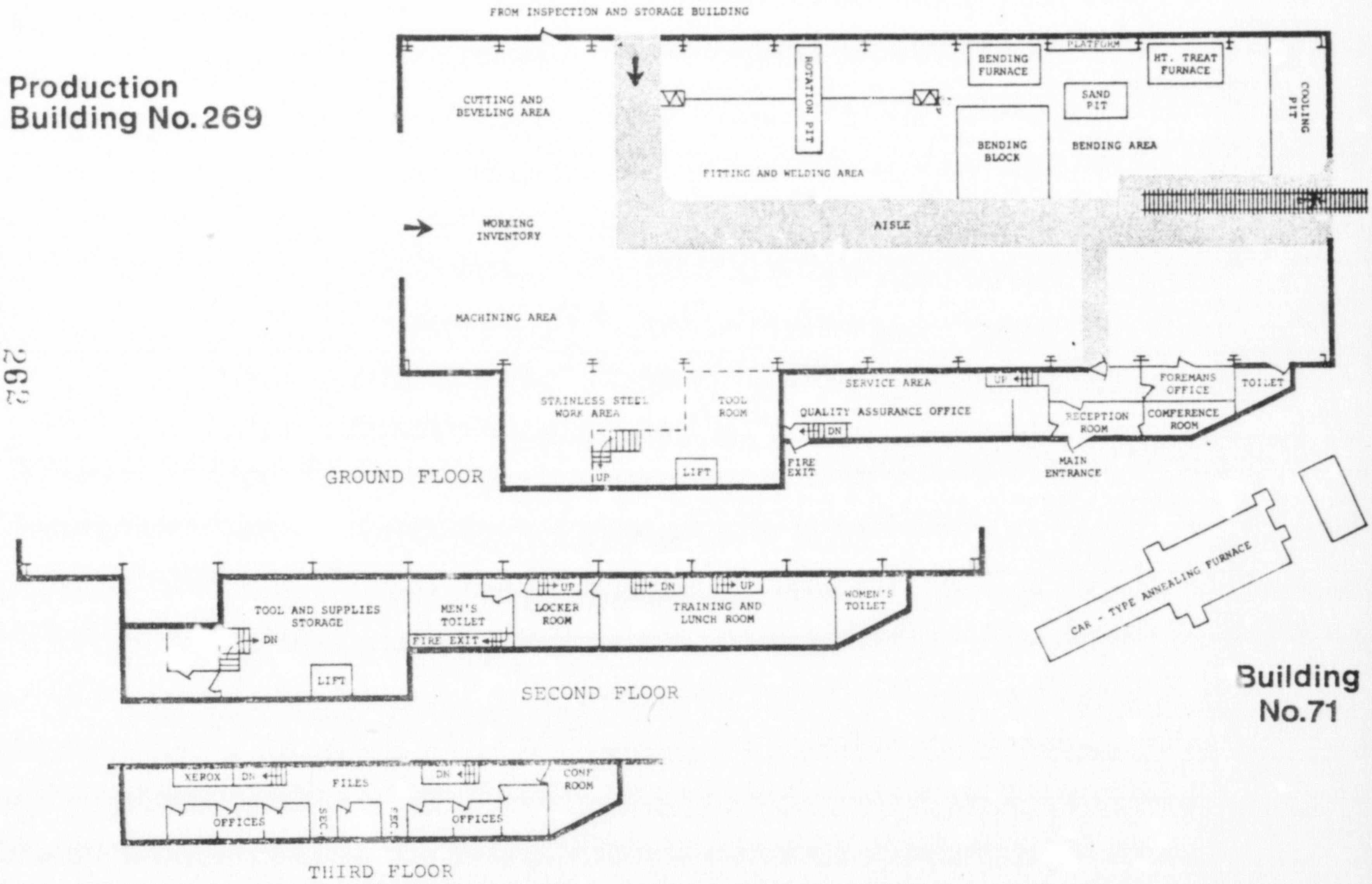
CAR TYPE ANNEALING FURNACE
Building 71 - Mobile Weather
Protection Shed in Foreground



INSPECTION AND SHIPPING BUILDING
Deep Water Berth in Foreground
Fabrication Shop in Left Background

CRIPPEN PIPE FABRICATION CORPORATION

Production Building No. 269

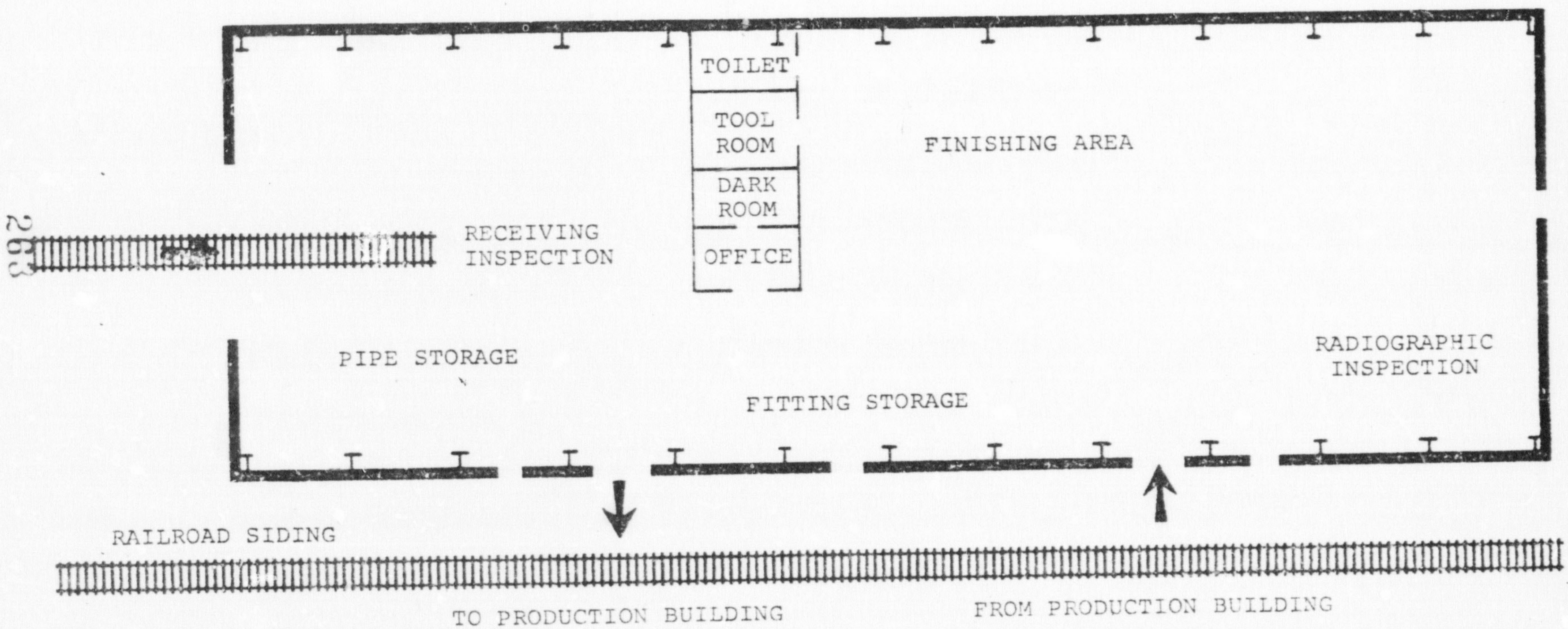


Building No.71

262

CRIPPEN PIPE FABRICATION CORPORATION

Inspection & Storage Building No. 268



EQUIPMENT

CUTTING AREA
1- Pipe Cutoff Machine - Gas Torch Cutoff
1- Pipe Bevel Grinder
1- Neck and Miter Cut Attachment
1- Wallace 3400 Abrasive Cut Machine
1- Armstrong-Blum Model 8/M2 Marvel Band Saw
Electric Arc Cutting Equipment

BENDING AREA
1- Sand Tower with Vibrators
1- Gas Fired Bending Furnace with Fully Automated Controls
12'-3" Long, 4'-0" Wide, 4'-0" High *
1- Patented Hot Pipe Bending Apparatus
1- Wallace Model 604-180 Cold Bender

FITTING AND WELDING AREA
6- Leveling and Layout Tables
8- Welding Machines:
Automatic and Semi-Automatic Submerged Arc,
MIG, TIG, Flux Cored, and Manual Metal Arc Equipment
1- Ransome Model 60P Positioner
2- Ransome Model 5P Positioners

MACHINING AREA
1- Vertical Drill Press
2- Rotating Head Beveling Machines
1- Fixed Head Beveling Machine
1- Pedestal Grinder
1- B&D Model 741 Magnetic Drill Press

HEAT TREATING AREA
1- ual Fired Furnace-Car Type with Fully Automated Controls
28'-0" Long, 12'-0" Wide, 12'-0" High *
1- Gas Fired Heat Treatment Furnace with Fully Automated Controls
10'-0" Long, 3'-0" Wide, 3'-0" High *
1- 160 KVA Electric Arc Model CGSF-10
Induction Stress Relieving Unit with Fully Automated Controls

FINISHING AREA
1- Sanstorm Model FSR Grit Blasting Unit
1- Distilled Water Tank and Demineralizer
Painting Equipment

* Inside Heating Chamber Dimensions

SPECIAL BENDING CAPABILITIES

It is expected that many piping configurations which are not practical or economical with current hot bending methods can be produced economically with the Crippen hot bending apparatus. Crippen Pipe Fabrication Corporation sales engineers will work with the client's engineers and designers to insure that maximum advantage is taken of these economic features.

CREDIT, the name of the patented hot bending apparatus invented by Mr. Crippen, produces wrinkle-free, full-area bends at a high production rate maintaining close tolerances. In addition to this capability, CREDIT enables the hot bender to bend-form 4, 5 and 6-bend compound pieces without a butt weld. A compound piece is defined as an assembly containing bends in more than one plane. Current industry bending equipment and methods usually require that these compound pieces be assembled from a series of single bends welded together.

Additional features of CREDIT which can provide the basis of customer design economies are:

a) CREDIT permits pipe to be bent in a continuous arc of up to 360 degrees without a weld.

b) CREDIT permits the most complicated compound bends to be bend-formed with zero tangents (no straight section) between bends.

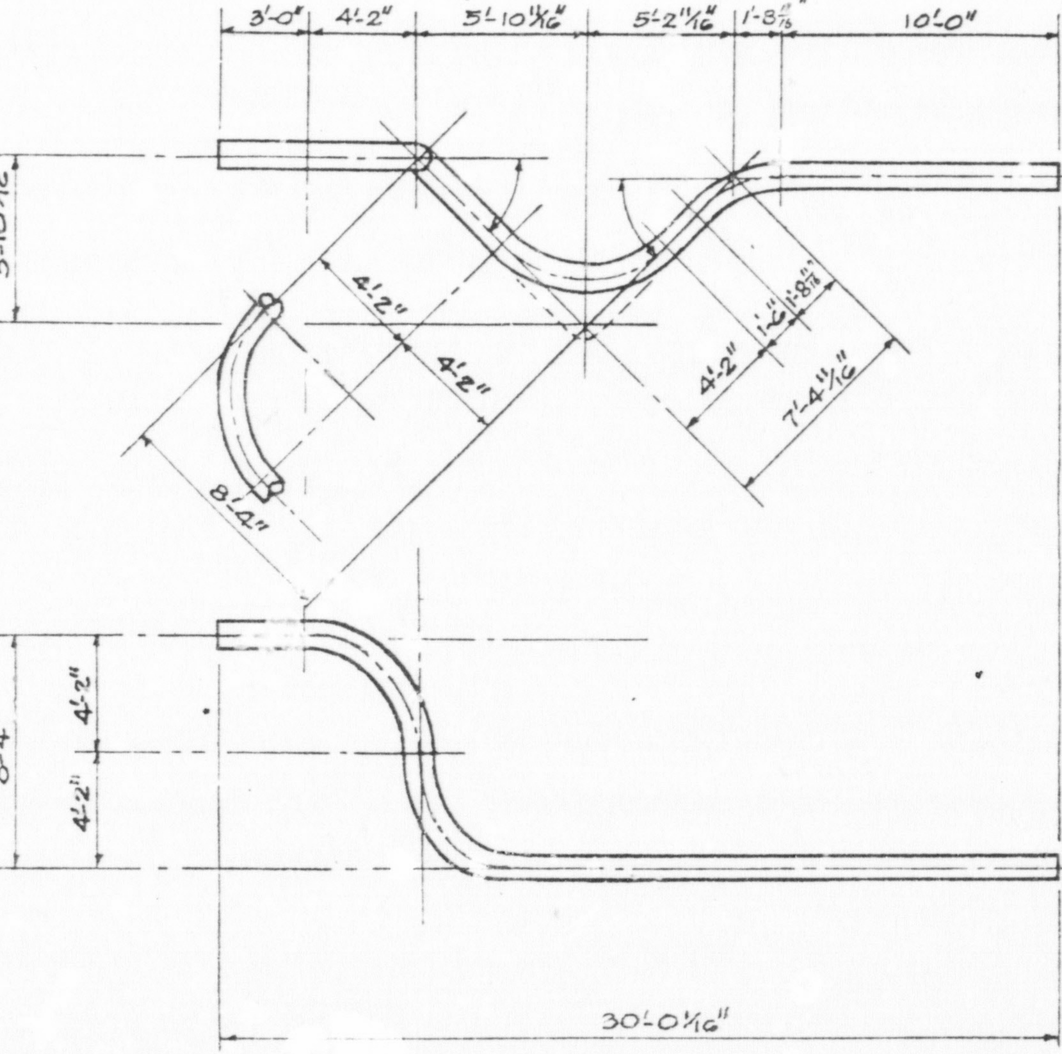
c) CREDIT offers safety for alloy pipe bending because of the rapid procedure which enables the bending to be finished while the heated pipe is at the proper hot bending temperature. For example, it will permit a 90-degree bend to be formed in a 12" diameter pipe in less than 3 minutes.

d) The precision accuracy of CREDIT will enable pipe to be bent after other fittings or attachments have been welded to the sections outside of the bend area.

e) CREDIT will enable compounds to be bend-formed on as many as three (3) different radii.

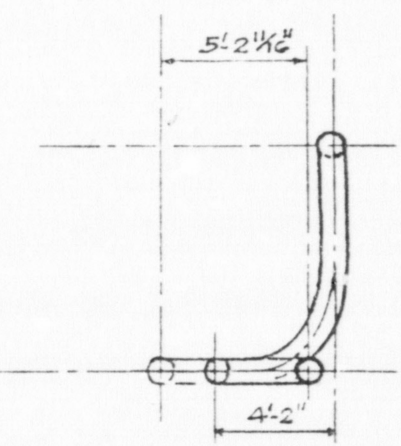
The examples cited are only a few of the features of CREDIT. CREDIT provides more than a dozen features that are not practical with conventional hot pipe bending equipment.

The drawings included in this brochure show 4, 5 and 6-bend compound pieces which can be formed without intermediate butt welds using CREDIT. These pieces require multiple-rotation, zero tangent and both clockwise and counter-clockwise bending.



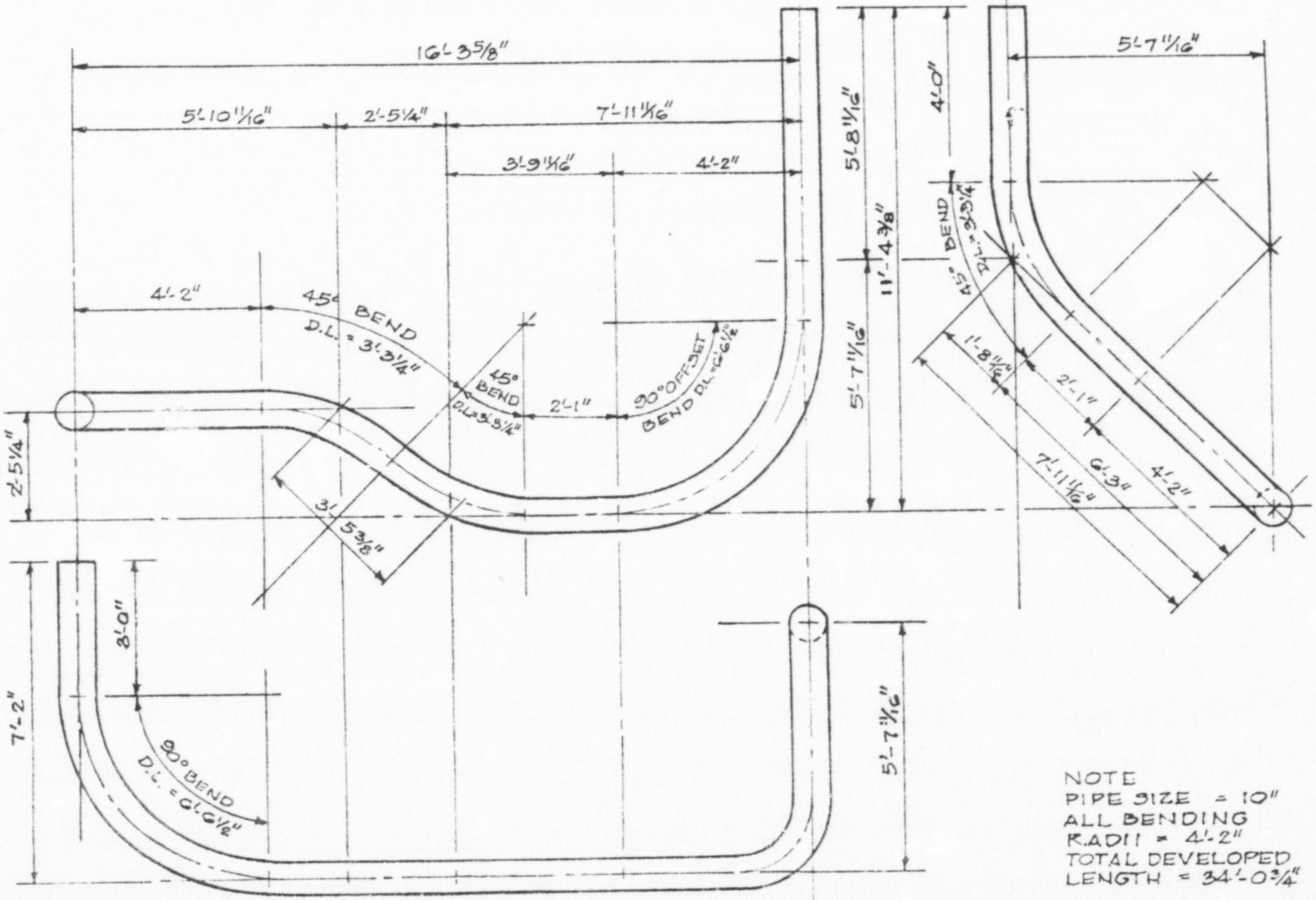
NOTE
PIPE SIZE = 10"
ALL BENDING
RADII = 50"
90° BEND ARC = 6'-6 9/16"
45° BEND ARC = 3'-3 9/32"

D.V. = 37'-5"



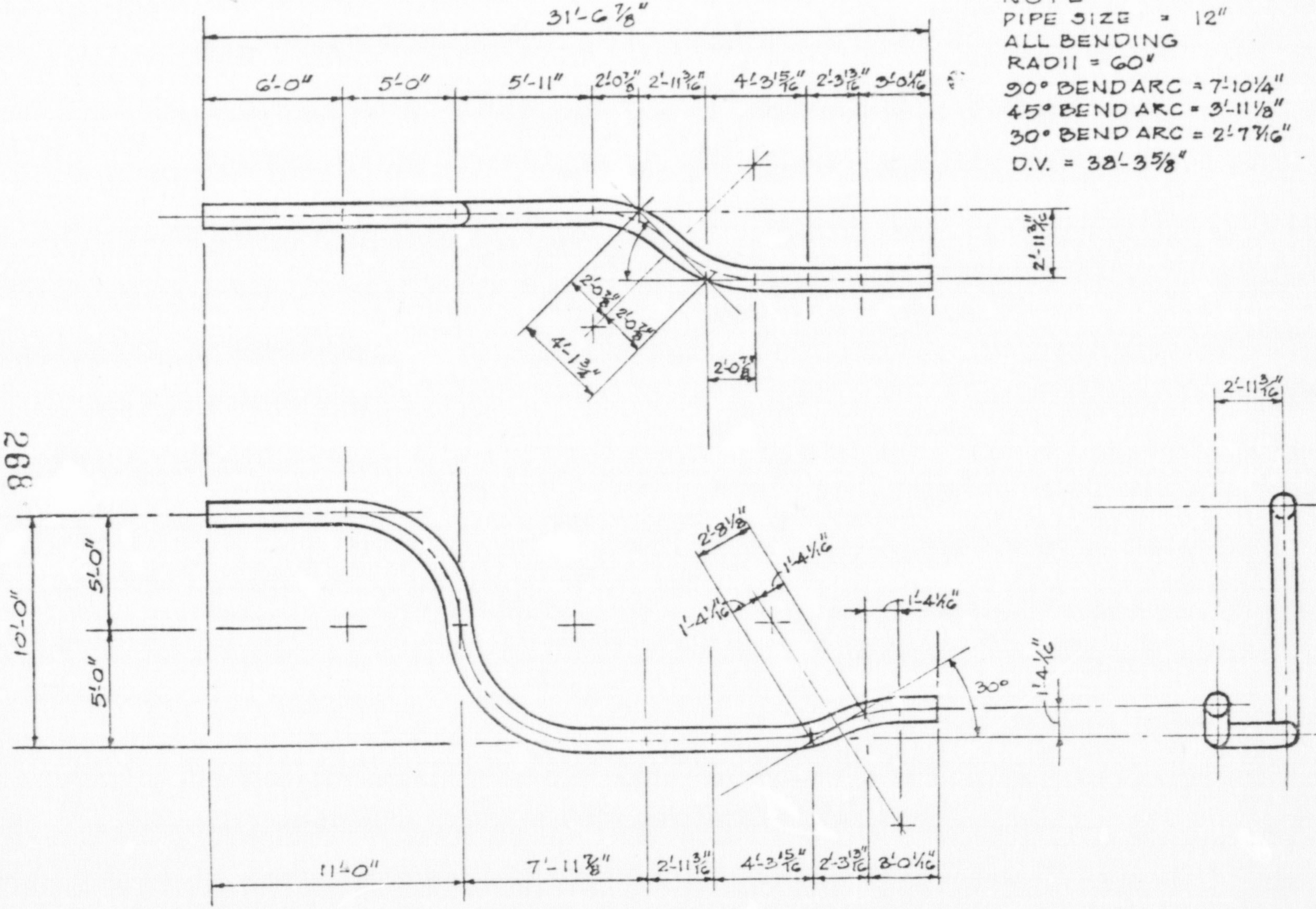
D Webster x 6

CRIPPEN PIPE FABRICATION CORPORATION



NOTE
PIPE SIZE = 10"
ALL BENDING
RADII = 4'-2"
TOTAL DEVELOPED
LENGTH = 34'-0 3/4"

D Webber X-5



NOTE
PIPE SIZE = 12"
ALL BENDING
RADII = 60"
90° BEND ARC = 7'-10 1/4"
45° BEND ARC = 3'-11 1/8"
30° BEND ARC = 2'-7 7/16"
D.V. = 38'-3 5/8"

CRIPPEN PIPE FABRICATION CORPORATION

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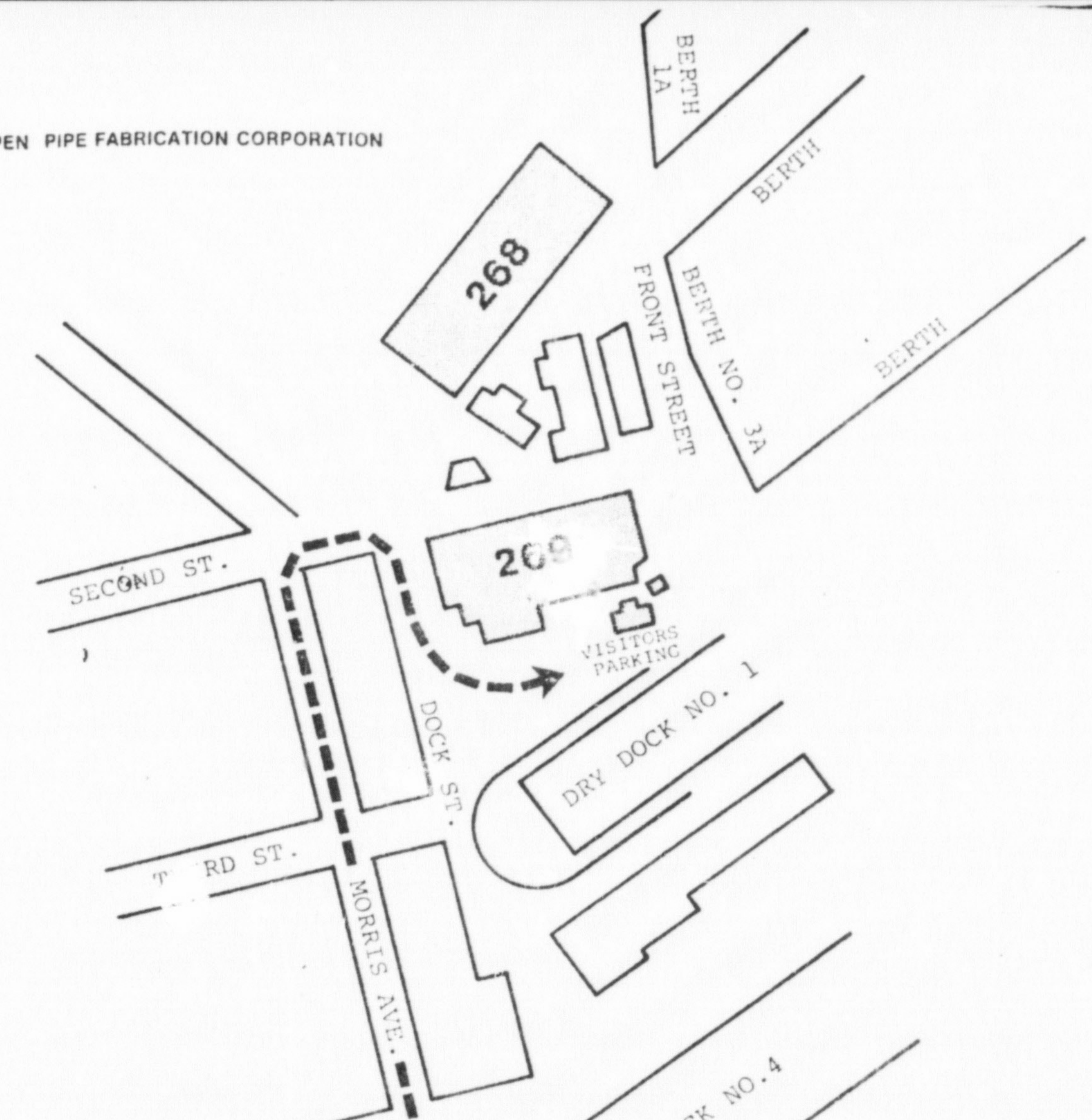
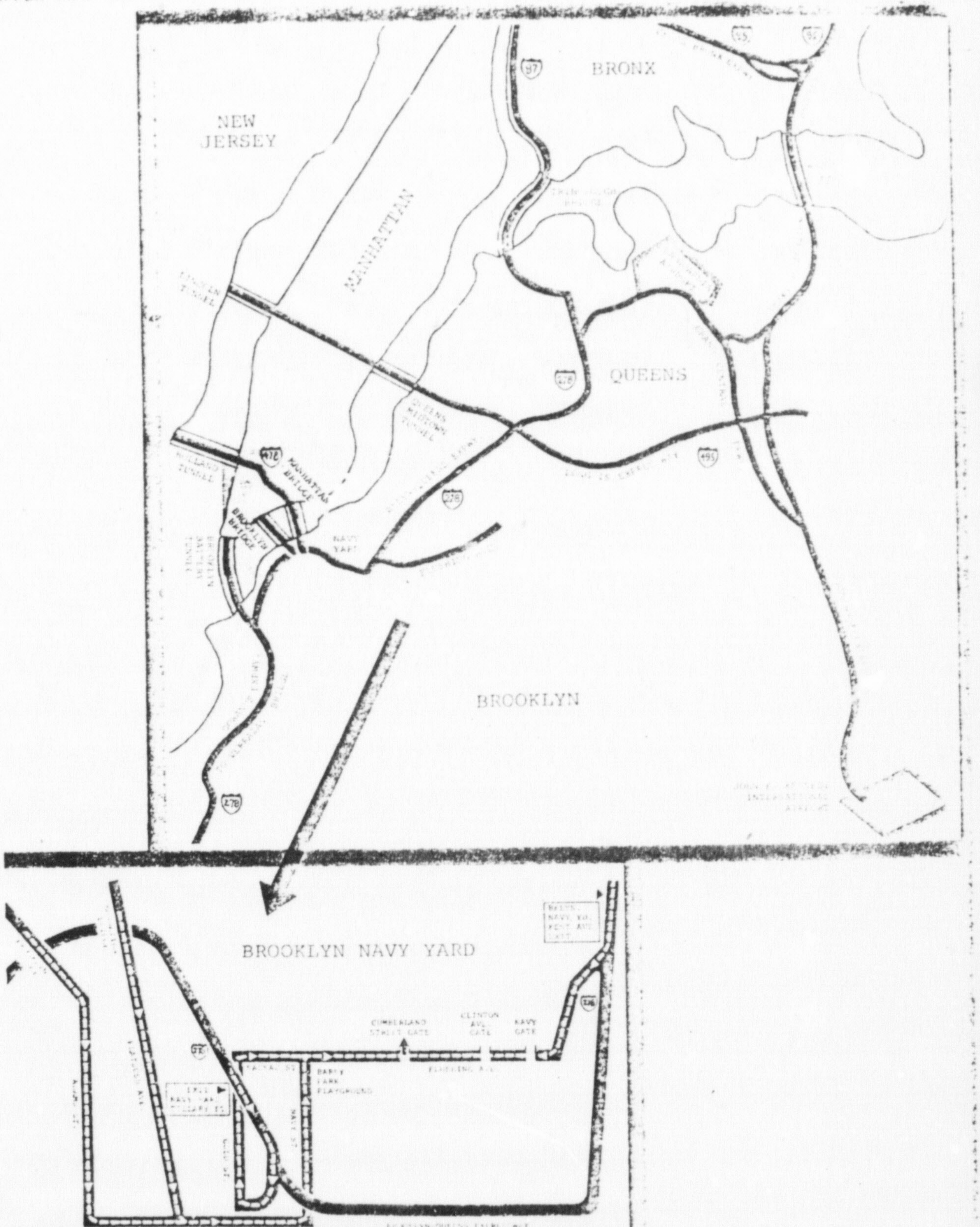
D Weibler X-4

CRIPPEN PIPE FABRICATION CORPORATION



LOCATION AND ACCESS MAP


NEW JERSEY
MANHATTAN
BRONX
QUEENS
BROOKLYN
87
95
278
478
495
LINCOLN TUNNEL
QUEENS MIDTOWN TUNNEL
HOLLAND TUNNEL
MANHATTAN BRIDGE
BROOKLYN BRIDGE
NAVY YARD
BROOKLYN NAVY YARD
CUMBERLAND STREET GATE
CLINTON AVE GATE
NAVY GATE
FLUSHING AVE
BROOKLYN-QUEENS EXPRESSWAY

Control No. 41

PDX-5

CRIPPEN PIPE FABRICATION CORPORATION

CONFIDENTIAL REPORT

June 1971

This report is for the confidential use only of persons to whom it is transmitted.

CRIPPEN PIPE FABRICATION CORPORATION

TABLE OF CONTENTS

CRIPPEN PIPE FABRICATION CORPORATION

I. DESCRIPTION OF THE COMPANY

1. Industrial Pipe Fabrication

The Crippen Pipe Fabrication Corporation is an industrial enterprise incorporated under the laws of the State of New York to be primarily engaged in heavy, industrial pipe bending and fabrication. The principal products of this company will be fabricated carbon steel and alloy pipe assemblies, as required in the construction of modern steam power plants, chemical plants and oil refineries.

Heavy industrial pipe fabrication is performed by a relatively few companies throughout the United States. The Pipe Fabricating Institute, the trade association which sets the technical and commercial standards for the industry, has a membership of twenty-one companies.(1)

2. Mr. Henry O. Crippen

Mr. Crippen, President of the Crippen Pipe Fabrication Corporation, has considerable experience and knowledge in the industrial pipe bending and fabrication business. He was in charge of pipe bending for the Sun Shipbuilding Corporation in Eddystone, Pennsylvania for a number of years. More recently, he was employed by Tubeco, Inc. (formerly Carl Pipe Bending and Fabricating Corporation) in Brooklyn, New York.

The hot pipe bending equipment at Tubeco's present plant was designed by Mr. Crippen and represents his early efforts to devise an improved pipe bending apparatus. Knowledgeable experts in the pipe

(1) See Appendix

fabricating industry have stated that the Tubeco equipment designed by Mr. Crippen was the best in the industry.

With Mr. Crippen as principal owner, the Crippen Pipe Fabrication Corporation will be the first black-owned company in the industrial pipe fabrication industry.

3. Patented Pipe Bending Apparatus

On July 22, 1969, the United States Patent Office issued (1) patent number 3,456,468 to Henry O. Crippen for a "Hot Pipe Bending Appartus and Method." Major cost savings can be achieved through the use of this invention because of the reduction in labor, shop time, rework and intermediate girth welds.

Mr. Crippen's patented apparatus represents a significant improvement over any equipment or method currently in use in the industry. All of the components or concepts embodied in this apparatus have been tested and proven of full-size equipment. Since filing the basic patent in 1967, Mr. Crippen has developed additional devices which provide further production cost savings.

(1) See Appendix

CRIPPEN PIPE FABRICATION CORPORATION

II. MARKET SURVEY

1. Overall Market

In 1969 the United States consumption of steel pipe and tubing of all grades and sizes from both domestic and foreign suppliers amounted to 10.5 million tons representing a wholesale value of approximately 3.5 billion dollars. Of this total, an estimated 700 million dollars or twenty percent was directed to fabricating shops for use in the construction of electric generating plants, chemical plants, oil refineries, petrochemical plants, water treating facilities, desalination plants, sewage treatment plants and pollution control facilities. The shop operations add roughly fifty percent to the value of the pipe materials. Thus, the United States market for shop fabricated pipe for use in power and process plants, both privately and publicly owned is about 1.1 billion dollars.

2. Areas of Concentration

The Crippen Pipe Fabrication Corporation plans to concentrate its marketing efforts in fabricated piping for power plants, process plants, and public construction.

a. Power Plants

The electric utility industry represents the most promising market for the Crippen Pipe Fabrication Corporation in respect both to growth rate and to normal profit margins. As stated in the November 1968 report to the Federal Power Commission by the Northeast Regional Advisory Committee, "When replacements of old-age and obsolete equipment are added to the growth requirements,

CRIPPEN PIPE FABRICATION CORPORATION

the power industry in Region I will need to build, between now and 1990, about four times as much capacity as it has provided in the eighty years of its history to the present time." The size of this Region I market can be better appreciated in light of the fact that this eleven state northeastern region contains 27% of the nations population.

The logical marketing area for the Crippen Pipe Fabrication Corporation corresponds roughly to Federal Power Regions I, II and III. The Edison Electric Institute's April 1970 listing of generating plants scheduled for construction in these three regions showed 120 fossil fuel fired plants totaling 62,000,000 kw and 53 nuclear plants totaling 48,900,000 kw. The value of the fabricated piping contracts for these plants is approximately 500 million dollars. In addition to these direct fabricated piping contracts, a sizeable quantity of pipe fabrication work is subcontracted by the boiler equipment suppliers such as Babcock and Wilcox, Combustion Engineering, Foster Wheeler and Riley Stoker.

Most of the direct contracts for power plant fabricated piping are placed by the engineering and construction contractors, although some utility companies such as Public Service and Niagara Mohawk do much of their own purchasing. As power plants are generally designed and purchased with fairly long lead times, the majority of the fabricated piping is purchased on a lump sum basis. Auxillary systems which are not defined completely in the early stages of design are more often awarded on the basis of an agreed upon set of discounts from the Pipe Fabricating Institute's standard price list. Typical discounts on fabricating labor operations run about fifty percent of the standard list price.

CRIPPEN PIPE FABRICATION CORPORATION

b. Process Plants

In 1970 the anticipated capital expenditure for United States chemical plants is 3.7 billion dollars, for oil refining plants is 0.8 billion dollars, and for petrochemical plants is 2.2 billion dollars. Of these amounts, the expenditures for fabricated piping are expected to be about two hundred fifty million dollars. Approximately thirty percent of these new plants are located in the probable marketing area of the Crippen Pipe Fabrication Corporation.

As with power plants, most of the purchase orders for process plant piping are awarded by the engineering and construction contractors. Because lead times for process plants are generally short, these purchase orders are almost always placed based upon a set of discounts from the Pipe Fabricating Institute's price list. Turnover is faster and price competition is keener in process plant work as compared with power plant work, with typical discounts on fabricating labor operations running between 55 and 60 percent of the list price.

c. Public Construction

Public construction represents a third strong market potential for the Crippen Pipe Fabrication Corporation, especially in light of the various government programs such as the federal set-aside programs to encourage minority-owned businesses. This market includes process and power plants being constructed for developing countries with AID funds, government-owned utility authorities such as the TVA, and piping systems for naval vessels.

CRIPPEN PIPE FABRICATION CORPORATION

3. Competition

Prior to forming the Crippen Pipe Fabrication Corporation, Mr. Crippen explored the possibility of marketing his patented hot pipe bending apparatus to a number of companies presently engaged in industrial pipe fabrication. While all of these companies expressed considerable interest in the apparatus, none of the offers received were sufficiently attractive to merit acceptance. In the course of these marketing efforts, Mr. Crippen was given the opportunity to observe and analyze the shop operations of a number of these pipe fabricating companies. His analysis of their shop operations and problems convinced Mr. Crippen that there was ample room in the industry for the Crippen Pipe Fabrication Corporation.

While the Thomas Register lists a substantial number of companies involved in pipe fabrication, most of these are not capable of handling the heavy industrial pipe bending and fabrication work that will be the mainstay of the Crippen operation. It is believed that none of the competitors presently has more than ten percent of the total market, and that the "captive market" is a small percentage of the total market. Principal competitors are: Tubeco, Inc., Brooklyn, N.Y.; Cornell-Underhill, Inc., Hoboken, N.J.; Charles Guyon, Harrison, N.J.; M.W. Kellogg, Williamsport, Pa, Houston, Texas and Los Angeles, Calif.; Power Piping Company, Pittsburg, Pa.; National Valve and Mfg. Co., Pittsburg, Pa.; B.F. Shaw, Wilmington, Del.; Dravo Corp., Marietta, O. and Charlotte, N.C.; Piping Engineering Co., Tulsa, Okla.; Texas Pipe Bending, Houston, Texas; Grinnell Corp., Warren, O. and Providence, R.I.

FOSTER WHEELER CORPORATION

Engineers • Manufacturers • Constructors

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J. 07039

BRANCHES IN PRINCIPAL CITIES OF
THE UNITED STATES AND CANADA
ALSO LONDON, PARIS, MILAN AND TOKYO

CABLE ADDRESS:
FEWOP LIVINGSTONNEWJERSEY
TELEPHONE 533-1100
(AREA CODE 201)

October 29, 1970

Mr. Henry Crippen
Crippen Pipe Fabricating Corporation
P. O. Box 217
Bronx, New York 10456

Dear Mr. Crippen:

It was with great pleasure that I learned of the formation of the Crippen Pipe Fabricating Corporation and your proposed location in the New York Area.

As a result of the many contacts with you, Foster Wheeler has acquired a considerable amount of respect for your knowledge of pipe fabricating techniques and believes that a company under your direction should have a real opportunity for success.

When you are in a position to firmly establish the existence of a facility having the required types of equipment and controls, we will be not only pleased but anxious to solicit quotations from your company for the various types of fabricated pipe used by Foster Wheeler. Whenever you are prepared to discuss this matter in detail, we will be pleased to have you visit Livingston to meet all of the people concerned with the purchase of fabricated pipe.

Best wishes for the success of your new and promising venture.

Very truly yours,

Marcus N. Brooks

Marcus N. Brooks
Corporate Director of Purchases
and Traffic

MNB:pt

Eck Cripple

Babcock & Wilcox

Power Generation Division

Barberton, Ohio 44203

Telephone: (216) 753-4511

November 3, 1970

Mr. Henry O. Crippen
P. O. Box 217
Morrisania Station
Bronx, New York 10456

Dear Mr. Crippen:

We ... ery pleased to hear, through our mutual friend Mr. A. C. Tendler, ...t you are starting a new venture in the pipe bending business. We know, from our close association dating back to 1963, that you are well qualified to embark in this field and, having evaluated your methods of pipe bending, we are sure that you will produce a high quality product.

Based upon our knowledge of your attributes, we would consider you a competent potential subcontractor --- and when your facilities are operational, we would appreciate discussing with you the possibility of subletting contracts which may be of mutual advantage.

Very truly yours,

Geo. W. Kessler

G. W. Kessler
Vice President

GWK/fo

cc: JLFrease
TBHarris
JFHarvey
ECKingsland
ACTendler

9

COMBUSTION DIVISION, COMBUSTION ENGINEERING, INC.
WINDSOR, CONN 06095
203-688-1911 CABLE: COMBENG

CE COMBUSTION DIVISION

November 17, 1970

Crippen Pipe Fabrication Corp.
P. O. Box 217
Bronx, New York 10456

Attention: Mr. Henry O. Crippen Re: Pipe Fabrication

Gentlemen:

Mr. Bonner has referred your letter of November 9 to this department for answering.

We are constantly on the lookout for qualified, competitive sources of supply and will welcome your entrance into the fabricated pipe business. We are, of course, restricted to doing business with those companies who can supply us a quality product and this would necessitate an audit and approval of your facilities by our Engineering and Quality Control Departments.

Please advise when your facilities have been established so we can take further steps to arrange for the necessary audit and to begin sending you inquiries for this product.

Very truly yours,

COMBUSTION ENGINEERING, INC.

A. G. Kelland

A. G. Kelland, Manager
Purchasing Department
Combustion Division

AGK:d

SUN SHIPBUILDING & DRY DOCK CO.

CHESTER, PENNSYLVANIA

R. GALLOWAY
VICE PRESIDENT
DIRECTOR OF OPERATIONS

October 29, 1970

Mr. Henry O. Crippen
Crippen Pipe Fabrication Corp.
P. O. Box 217
Bronx, New York 10456

Dear Sir:

Confirming our recent telephone conversation, I think I can safely say that Sun Shipbuilding & Dry Dock Company would consider having certain portions of our pipe work sub-contracted to you, in the event that you can demonstrate both the ability to perform the work, and a cost saving to Sun Ship.

The amount of such work would, of course, vary with our current work load, both in Shipbuilding and Industrial Products. The criterion would be simple enough - we would want to hot bend any pipe which could be done more economically by this method than* by use of pipe fittings and welding. Since we have a considerable amount of large tanker work ahead of us, there may be substantial quantities of pipe which could be economically bent.

Very truly yours,

K. Damsgaard
General Superintendent E/O/W

KD:v

CC: R. Galloway
L. Triboletti
F. Metrick
File

*Note:
A cost comparison of these two methods is contained in Section VI. 5. of this report showing the substantial savings obtained by using the hot bend method.

RILEY *Stoker Corporation*

WORCESTER, MASSACHUSETTS 01601

STEAM GENERATING AND FUEL BURNING EQUIPMENT

W. H. CROSS
VICE PRESIDENT — MANUFACTURING GROUP

October 21, 1970

Crippen Pipe Fabricating Corp.
Box 217
Bronx, N. Y. 10456

Attention: Henry O. Crippen, President

Dear Mr. Crippen:

This is to confirm our telephone discussion on October 19, 1970.

Each of our major boiler contracts requires the bending and welding of large diameter, heavy wall pipe. We do not perform this work in our own shops but rather subcontract with a pipe fabricator.

We would be pleased to consider Crippen Pipe Fabricating Corp. as a potential subcontractor for this type work in the future.

Very truly yours,

RILEY STOKER CORPORATION

W H Cross

W. H. Cross,
Vice President, Manufacturin

WHC:amr

MURRAY

TUBING & PIPE · SINCE 1845

October 19, 1970

Mr. H. O. Crippen
Post Office Box 217
Morrisania Station
Bronx, New York 10456

Dear Mr. Crippen:

I was pleased to learn that you, together with a few associates, plan to form a new Company called "Crippen Pipe Fabricating Corp."

I recall discussing with you, back in 1968, the process and technique for making bends in large diameter heavy wall pipe and tubes.

As you may recall, our own bending facilities are limited to 4" pipe size and smaller, and if and when we do get inquiries for larger OD material we will give you an opportunity to quote on such requirements.

We hope you will be successful in this new undertaking.

Very truly yours,

A. B. MURRAY CO., INC.

Ray B. Siegrist

R. B. Siegrist
President

/jd

CRIPPEN PIPE FABRICATION CORPORATION

III. MANUFACTURING PLAN

1. Facilities

The facilities obtained for the company's operations are located in the former Brooklyn Navy Yard. The manufacturing plant is a heavy duty, single floor, high ceiling industrial building containing approximately 30,000 square feet. An overhead, 20-ton bridge crane serves the entire manufacturing area. A rail siding comes into the building at one end and connecting sidings are located along each side of the building. Barge berthing facilities are available within a couple of hundred feet from the manufacturing building. Office space and locker room facilities are located in a separate building adjacent to the manufacturing building.

Utilities provided include 440/208/120 volt, 3-phase electric power, natural gas, heating steam, 100 psig compressed air, city water and sanitary sewers.

The Crippen Pipe Fabrication Corporation has obtained an option on a ten year lease for these facilities.

2. Equipment

The Production, Quality Assurance and Materials Handling Equipment which will be installed in the manufacturing building is described in detail in a separate booklet. This equipment includes the following items:

a. Production and Quality Assurance Equipment

1) Hot Pipe Bending Apparatus

2) Pipe Bending and Stress Relieving Furnace (Two Units)

CRIPPEN PIPE FABRICATION CORPORATION

3) TIG Welding Equipment
4) MIG Welding Equipment
5) Submerged Arc Welding Equipment (Two Units)
6) AC/DC Manual Shielded Metal Arc Welding Equipment (Four Units)
7) Induction Stress Relieving Unit
8) Pipe Cutting and Burning Equipment
9) Pipe Beveling Machine (Two Units)
10) Electric Arc Cutting Equipment
11) Pipe Positioner - A
12) Pipe Positioner - B (Two Units)
13) Abrasive Cut Off Machine
14) Cold Pipe Bending Machine
15) Magnetic Drill Press
16) Drill Press
17) Band Saw
18) Engine Lathe
19) Pneumatic Grinder (Six Units)
20) Sand Blasting Machine
21) Electrode Oven (Six Units)
22) Flux-Holding Oven
23) Ultrasonic Thickness Tester
24) Miscellaneous Equipment

b. Materials Handling Equipment

1) Bridge Crane

CRIPPEN PIPE FABRICATION CORPORATION

2) Jib Crane - A (Two Units)

3) Jib Crane - B (Four Units)

4) Jib Crane - C (Four Units)

5) Industrial Truck Crane

3. Manufacturing Schedule

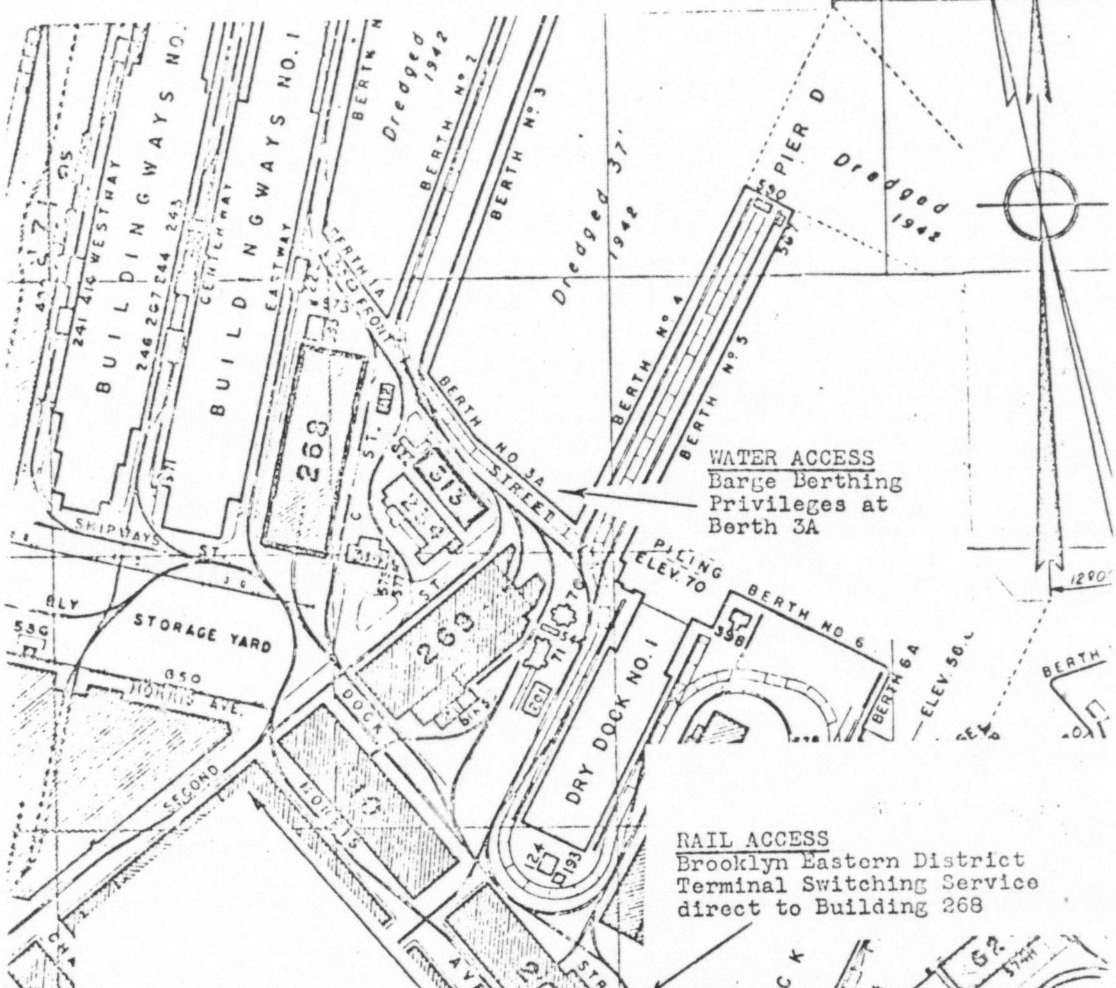
The basic manufacturing schedule calls for an initial [redacted] period for facilities set-up and testing, followed by a [redacted] period of initial production, during which a [redacted] sales rate is attained. In each of the [redacted] years the annual sales rate is increased by an additional [redacted] so that an annual sales rate of [redacted] is achieved by the end of the [redacted] year. This production rate represents approximately [redacted] of the ultimate plant capacity of [redacted] sales rate based on a [redacted] shift operation.

Activities involved in the set-up and testing period include installation of facilities, production and quality assurance equipment, hiring of initial staff, testing of equipment, negotiation of union label agreement, qualification of welding procedures, production of sample assemblies, development of sales materials, and establishment of minimum inventories.

At the outset of the initial production period, ASME code certification will be obtained, additional personnel will be hired and normal job procedures will be established. ASME nuclear certification will be obtained one year later.

CRIPPEN PIPE FABRICATION CORPORATION
Brooklyn Navy Yard, Brooklyn, New York

Administrative Office - Building 313
Manufacturing - Building 268



CRIPPEN PIPE FABRICATION CORPORATION

IV. MARKETING PLAN

Throughout the marketing program the company is seeking to take advantage of the special aspects of its "personality", both those that are obvious assets, as well as some that might be thought of as liabilities. Obvious assets include the ownership of the patented apparatus for producing top-quality, low-cost hot bends and the fact that special care is being taken in developing and maintaining a closely-knit workforce. Advantage will also be taken of the facts that might appear to be liabilities, namely that the company is operating in the metropolitan New York area, and that it is a small, young company.

All marketing activities will be handled by company personnel based at the plant site.

1. Union Agreement

It is essential for acceptance of its fabricated piping at construction sites that the company obtain a "union label" agreement with the UA Pipefitters Union. Fortunately, Mr. Crippen has been a member of this union for over twenty-five years. In view of the widespread criticism that the Pipefitters Union has been subject to recently regarding access by minority individuals, it is believed that the union will welcome this opportunity for favorable publicity. By concluding a fair and equitable contract with the Crippen Pipe Fabrication Corporation, the union will be assisting one of its long time black members in setting up his own company.

2. Cost Savings and Quality Assurance

With the projected cost savings through the use of the patented hot bending apparatus, it is expected that high quality products will be produced while keeping costs equal to or slightly below the competition. The principal marketing message at all levels of customer contact must be one of quality assurance. Early certification by the ASME Boiler Code authorities is essential. Special certification required for nuclear systems fabrication will be sought after approximately one year of full production of conventional boiler systems. All shop personnel will be encouraged to feel that they are an important part of the quality assurance marketing effort so that this message is clearly communicated in the course of product and shop inspections made by client personnel.

3. Advance Sales Commitments

Most engineering contracting organizations and operating companies doing business in the northeastern United States would welcome additional competition in the pipe fabricating industry. Every effort will be made to solicit advance sales committments from these organizations, particularly those that might be interested in assisting the establishment of a minority-owned business operating in the metropolitan New York area.

4. Contractors Market Development

As the largest volume of fabricated pipe business is placed by the engineering contractors, the major marketing effort must be

directed to them. Fortunately, many of these organizations are located in the New York - Boston - Philadelphia area, so that shop visits for client personnel can be arranged with a minimum expenditure of time and money. The marketing program will take advantage of this convenience of shop qualification and product inspection plant visits. The extensive experience of the General Manager, Mr. Bruce Wallace, in the management operations of a major engineering contractor will be valuable in fully developing this market.

5. Operating Company Market Development

The companies that operate power or process plants have the most to gain from increased competition in the fabricated pipe industry. Many of these operating companies maintain sizable engineering and procurement organizations and place a sizable volume of fabricated pipe orders. This market will be developed similarly to the engineering contractors market.

6. Government Set-Aside Programs

As the first minority-owned enterprise in the industrial pipe fabricating industry, the Crippen Pipe Fabrication Corporation will be in a unique position regarding federal set-aside programs. Under the President's Procurement Task Force on Minority Business Enterprise and the General Services Administration, some one hundred forty million dollars has been made available to provide special contract opportunities for minority -owned enterprises such as this one. With other federal agencies or authorities such as AID and TVA, this market has national and even international possibilities.

7. Special Programs

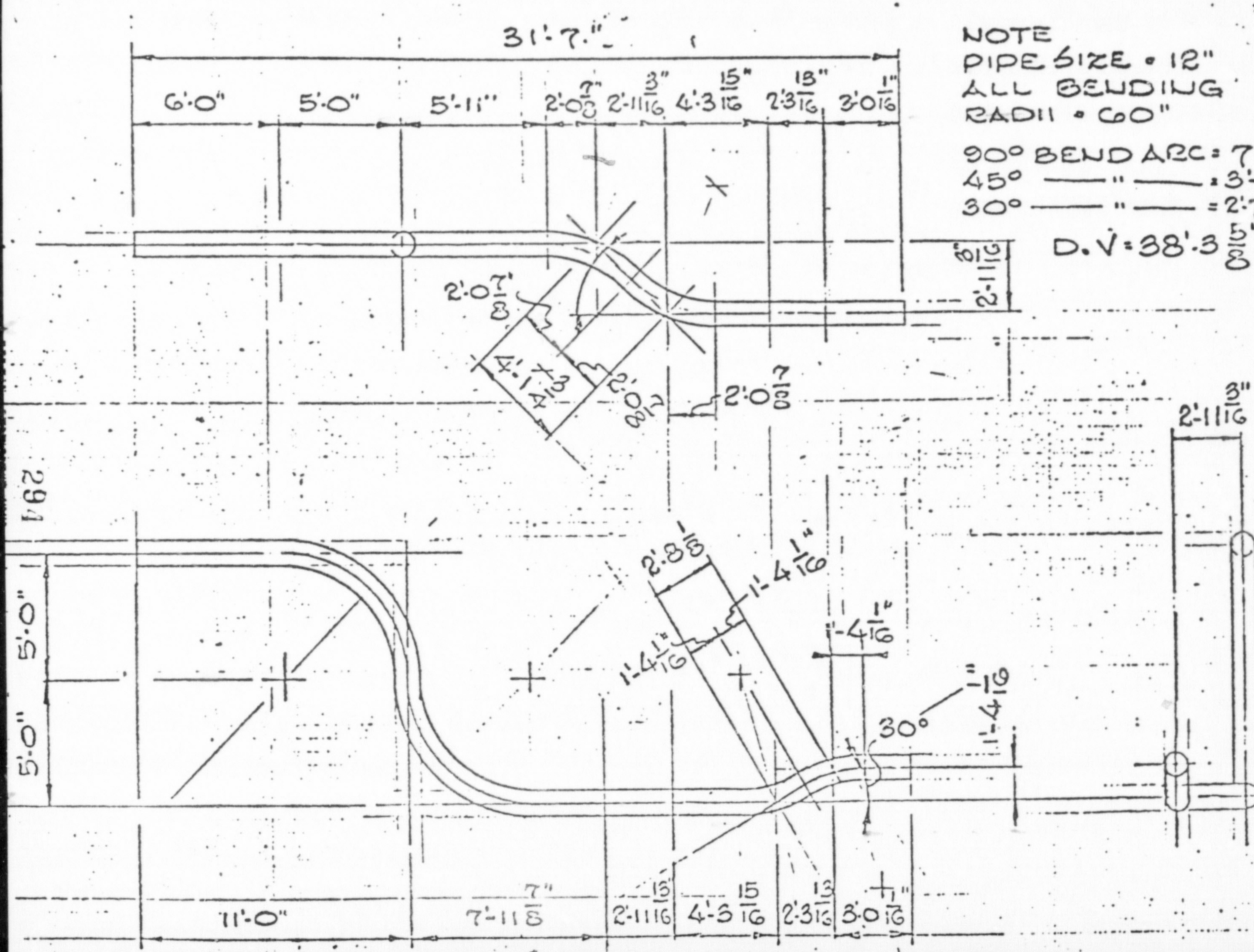
It is expected that many piping configurations which are not practical or economical with current production methods can be produced economically with the Crippen hot bending apparatus. Company sales engineers will work with client engineers and designers to insure that maximum advantage is taken of these product features.

CREDIT, the name given to the patented apparatus by Mr. Crippen, produces wrinkle-free, full-area bends at a production rate while maintaining dimensional tolerances within closer limits than those set by the Pipe Fabrication Institute. In addition to this capability, which is not provided by current equipment and methods, CREDIT enables the hot bender to form 4, 5 and 6 - bend compound pieces without a butt weld. A compound piece is defined as an assembly containing bends in more than one plane. Current industry bending equipment and methods require that these compound pieces be assembled from a series of single bends welded together. The drawings and explanatory notes on the following pages, 20A through 20F, illustrate this feature. These are only a few of the various combinations which can be bendformed to eliminate welds with CREDIT.

Additional features of CREDIT which can provide the basis for special marketing programs are:

a) CREDIT permits a pipe to be bent in a continuous arc of up to 360 degrees without a weld.

b) CREDIT permits the most complicated compound bends to be bend-formed with zero tangents (no straight section) between bends.



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CRIPPEN PIPE FABRICATION CORPORATION

20 A
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c) CREDIT offers safety for alloy pipe bending because of the rapid procedure which enables the bending to be finished while the heated pipe is at the proper hot bending temperature. For example, it will permit a 90-degree bend to be formed in a pipe in less than 3 minutes.

d) The precision accuracy of CREDIT enables pipe to be bent after other fittings or attachments have been welded to the sections beyond the bend.

6 - Bend Compound - 12" Standard Wall Pipe

Drawing 20 A represents two compound pieces which were fabricated with the same dimensions, but they were fabricated in opposite directions. One of these 6-bend compound pieces was for the right side of a construction, and the other 6-bend compound piece was for the left side of the construction. A total of twelve (12) bends were required.

As shown on the drawing, the two 90-degree bends, the two 45-degree bends, and the two 30-degree bends were to be either bend-formed or fabricated from single bends welded together with no (zero) tangents between the bends. If they were bend-formed the compounds would require multiple rotation - bending, and both clockwise and counterclockwise bending.

Fabrication from Single Bends

Because of the difficulty in rotating and forming bends with no straight tangent between them, and the inability to do both clockwise and counterclockwise bending, these bends each were formed as single bends. Time required for bending these 12 single bends: 56 man-hours

The method used in forming these bends caused seven of them to buckle, wrinkle and flatten, and the ovality of the bends was as much as 1 1/16". While the sand was still in the pipes, each buckle was reheated and hammered-down. Time required: . . . . 23 man-hours

Then the bends were layed-out for checking angle and dimensional accuracy. Three of these bends were found to be over-bent and one bend was under-bent. These four bends had to be reheated and corrected to get the angle accurate. Time required for laying-out the 12 bends and correcting the 4 angles: . . . . . . 19 man-hours

Then the pipes were emptied of sand, and the bends were cut. The 7 distorted pieces were re-worked. The wrinkles and flat-spots were jacked-out. This operation required each of these bends to be reheated several times. Time required: . . . . 39 man-hours

The ovality at the ends of each of the 12 bends had to be rounded-out, and the 12 ends had to be hand-beveled for joining. Time required: . . . . 16 man-hours

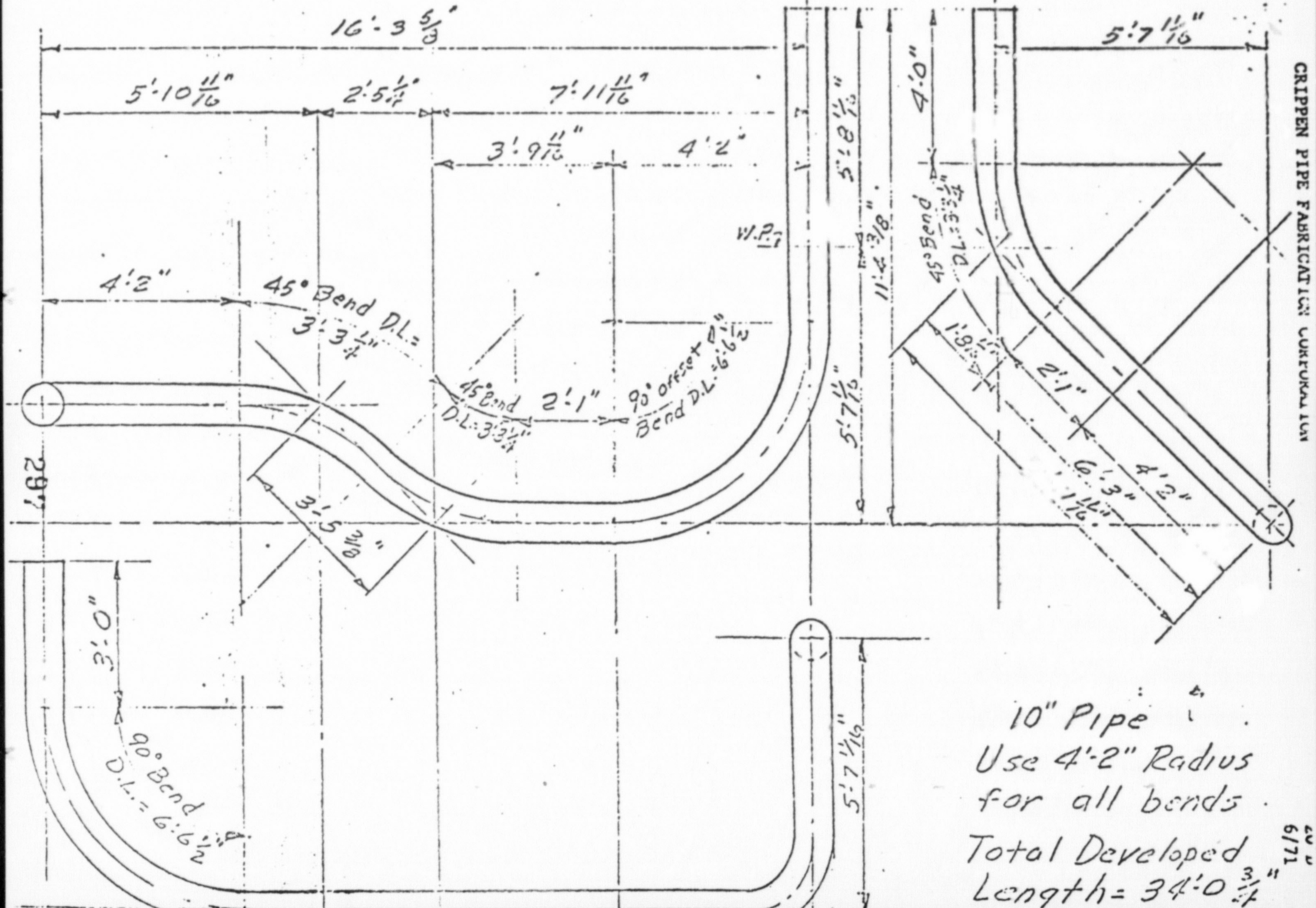
Then a floor lay-out was made for the final adjustments and fitting the 12 bends. Time required: . . 32 man-hours

Finally, welding the joints and patching-up the thin areas in the bends (which resulted from excessive reheating and hammering, etc.). Time required: . . 27 man-hours

Total time 212 man-hours

Bend-Forming with CREDIT

WITH CREDIT THESE TWO COMPOUNDS CAN BE BEND-FORMED WITH WRINKLE-FREE, FULL-AREA BENDS, AND WITHOUT WELDS. TOTAL TIME REQUIRED TO BEND-FORM THESE TWO COMPOUND PIECES: . . . . 34 man-hours



10" Pipe
Use 4'-2" Radius
for all bends

Total Developed
Length= 34'-0 3/4"

CRIPPEN PIPE FABRICATION CORPORATION

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5-Bend Compound - 10" Schedule 160 Pipe

Drawing 20 D shows a compound piece that was fabricated from single bends welded together to form the compound. This procedure entailed: Lay-out work; beveleing; boring; fitting; welding; radiographic inspection, and stress relieving the welded joints.

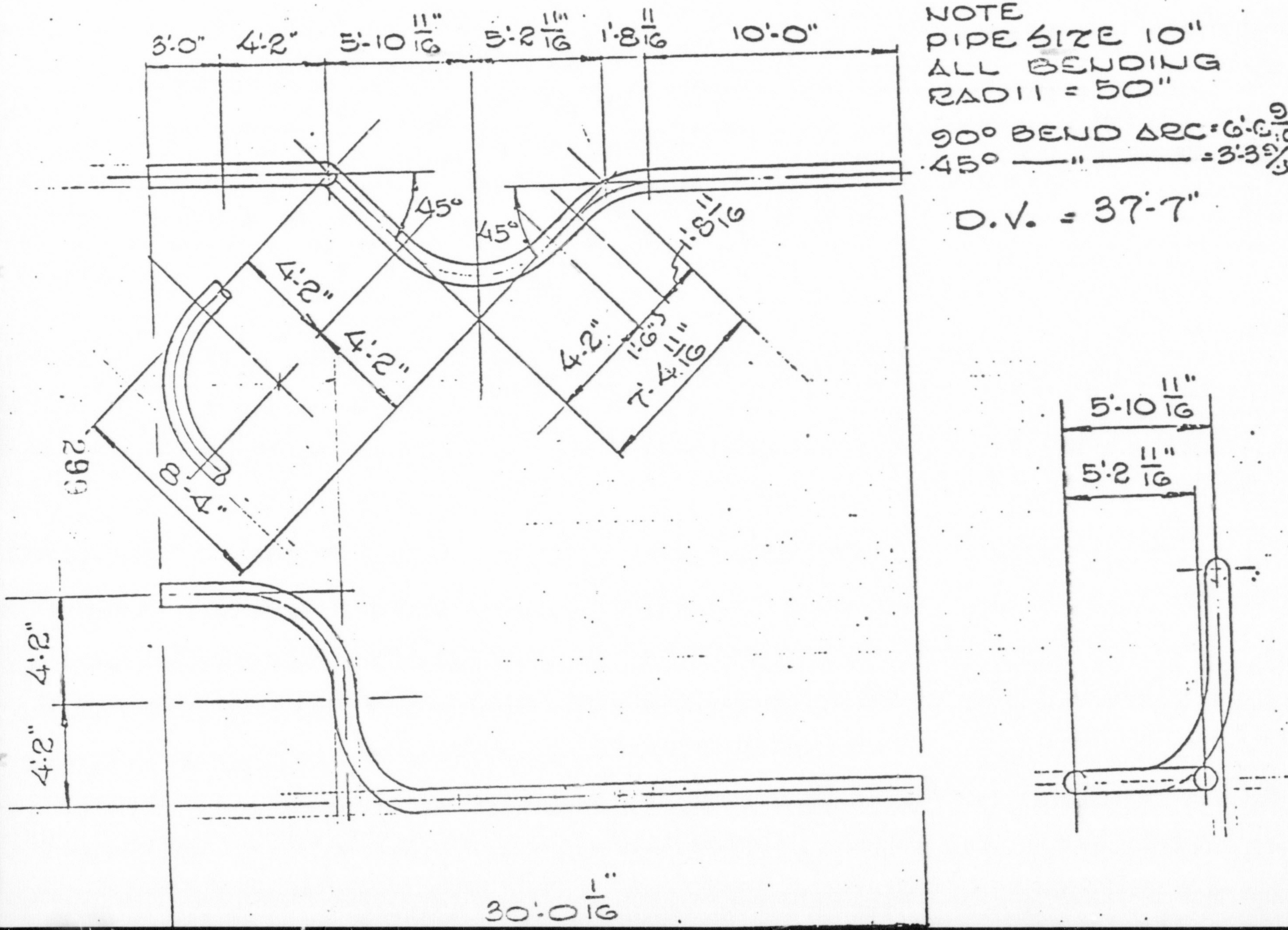
By the use of CREDIT (which eliminates welds and other fabricating costs) this 5-bend compound piece can be bend-formed , and 75% of the man-hours required by the standard practice can be saved.

4-Bend Compound - 10" Pipe Size X 2.25" Wall

Drawing 20 F shows a 4-bend rotation compound piece consisting of three 90-degree bends with no tangents between bends, and one 45-degree bend. This compound piece, if bend-formed, calls for both clockwise and counter-clockwise bending.

The piece shown on this print is for the right side of a plant. A duplicate piece is required for the left side of the construction. Both pieces have the (exact) same dimensions, but they are to be bend-formed or fabricated from single bends welded together in opposite directions (one right and one left).

If these pieces cannot be bend-formed there will be twelve (12) "no-tangent" ends to be machined for the pieces to be fabricated. To be able to bend-form these two pieces can save upward of 130 man-hours in fabricating time. This would expedite the delivery date by a number of days.



NOTE
PIPE SIZE 10"
ALL BENDING
RADII = 50"

90° BEND ARC = 6'-6 9/16
45° ——"—— = 3'-3 9/32

D.V. = 37'-7"

CRIPPEN PIPE FABRICATION CORPORATION

CRIPPEN PIPE FABRICATION CORPORATION

V. ORGANIZATION

1. Functional Responsibilities of Management Personnel

President

Personnel Management

Production Development

General Manager

Operations Management, Planning and Development

Vice President - Sales

Sales Management

Project Management

Vice President - Finance

Purchasing Management

Financial Management

Chief Engineer

Quality Assurance Management

Facilities Management

Shop Foreman

Production Management

CRIPPEN PIPE FABRICATION CORPORATION

2. <u>Organization Chart</u> - End of First Year

President

General Manager

VP - Sales *	Chief Engineer *	Shop Foreman *	VP - Finance *
Project Engineer *	Maint. Engineer *	Pipe Fitter (5) *	Secretary-Bookkeeper
Project Engineer	Draftsman	Welder (4) *	Shipping Clerk
Secrtary		Pipe Bender (2) *	
		Machinist (2) *	
		General Shop Man *	
		Apprentice Mechanic	
		2nd Class Helper (2)	
		3rd Class Helper (2)	

* Resumes Available, not included in this report

CRIPPEN PIPE FABRICATION CORPORATION

PRESIDENT

HENRY O. CRIPPEN
601 E. 167th Street
Bronx, N.Y.

WORK EXPERIENCE

1966 to 1970 Self Employed

Developed invention of a hot pipe bending apparatus and method after leaving Tubeco, Inc. in January, 1966, filing for a patent in March, 1967. Initiated discussions and negotiations with numerous pipe fabricating companies regarding the possible sale or license of his invention. As part of these discussions, he was generally asked to observe and analyze the company's current shop operations.

Undertook various studies related to the establishment of his own pipe fabricating company. Continued development of additional hot pipe bending devices to provide further production cost savings.

1954 to 1966 Tubeco, Inc., 123 Varick Ave., Brooklyn, N.Y. (formerly Carl Pipe Bending Corporation)

Supervised and set up Carl Pipe Bending Corporation's high-pressure, hot pipe bending installation. Devised all of his own dies, jigs, bending shoes etc., frequently producing equipment never used before. Developed several unique methods in hot pipe bending which produced a superior product along with considerable savings for the company. Tested out during the course of his work most of the principles and concepts later incorporated into his invention. He was in complete charge of all hot pipe bending operations until 1961 when a back injury restricted him to light duties.

After 1961 served as a machinist and occasional consultant on hot pipe bending. This assignment afforded him an opportunity to become familiar with all of the shop operations.

1942 to 1946 Sun Shipbuilding and Drydock Corporation, Eddystone, Pennsylvania

Trained in all phases of hot and cold pipe bending. Progressed from trainee to Chief Hot Bender. Employment terminated when the Number Four yard was closed at the end of World War II.

Various other employment in construction and service activities.

PERSONAL Born: January 11, 1914 Princess Anne, Maryland
Married No Children

CRIPPEN PIPE FABRICATION CORPORATION

GENERAL MANAGER

BRUCE A. WALLACE
11 Myrtle Street
White Plains, N.Y.

WORK EXPERIENCE

1952 to 1970 - M.W. Kellogg Company, Division of Pullman, Inc. Engineering and Construction Contractors to the Chemical and Petroleum Industries

As Manager of the Furnace and Exchanger Division (1969 - 1970) he directed a staff of approximately fifty engineers and technicians.

As Manager of the Furnace Division (1966 - 1969) his primary responsibility was engineering design. Related responsibilities included preparation of technical proposals and cost estimates, sales presentations, project management, cost control, management of overseas licensee operations, coordination with procurement, fabrication, construction, research and development activities.

After his appointment to supervisory position in the Furnace Division in 1961, the Annual Product Volume of the Division was increased fivefold, from three to fifteen million dollars per year. Over 85% of the current Product Volume consists of new products developed under his supervision since 1961.

Prior work at Kellogg included varied assignments in the Piping Division, Operating Division and Machinery Division.

Author of several patents and technical articles

Licensed Professional Engineer

EDUCATION

Massachusetts Institute of Technology - B.S. in Mechanical Engineering - 1952
Columbia University - Graduate Study in Personnel Psychology

PERSONAL

Born: August 27, 1930 Chicago, Illinois

Married Three Children, Ages 9, 11 and 14

CRIPPEN PIPE FABRICATION CORPORATION

BOARD OF DIRECTORS

Henry O. Crippen - President

Bruce A. Wallace - Vice President

Samuel B. Fortenbaugh III - Secretary
Partner - Kelly, Drye, Warren, Clark, Carr & Ellis
350 Park Avenue, New York, N. Y. 10022

4. Training Plans

Fundamental to profitable production expansion is the on-the-job development of top quality mechanics. Apprentice programs will be set up in the mechanic classifications of welder, pipe fitter, machinist, hot pipe bender, and cold pipe bender. Lead mechanics in each of these categories have been selected with a high priority given to their demonstrated ability to train younger men.

The apprentice training programs will include on-the-job instruction, classroom instruction, periodic tests, and job classification advancement based on these tests and demonstration of job skills. Classroom instruction will include approximately twelve sessions in each of such subject areas as shop mathematics, blueprint reading, welding, quality control etc. After one year the apprentice will be eligible for advancement into the semi-skilled mechanic classification; after one year more he will be eligible for advancement into the junior mechanic classification; and after a final eighteen-month period he will be eligible for advancement into the senior mechanic (journeyman) classification.

All employees will be encouraged to pursue outside studies in technical and business subjects through tuition reimbursement for successfully completed courses. Through the profit-sharing program, the company hopes to develop interest and understanding on the part of all employees in the total business operations of the company.

CRIPPEN PIPE FABRICATION CORPORATION

5. Employee Compensation and Incentive Plans

The company recognizes that the key to successful operation in the Metropolitan New York area is an efficient and highly-motivited workforce.

While the exact details of the emplyee compensation and benefit arrangements will depend upon the contract negotiated with the UA Pipefitters Union, it is the intention of the company that the total package be at least equivalent to that offered by area industries.

It is planned to aid every employee in becoming a stockholder in the corporation. A profit-sharing system for all employees will be developed to encourage teamwork, broad understanding of company operations and problems, and involvement by all company personnel in operations improvement.

CRIPPEN PIPE FABRICATION CORPORATION

PROJECTED INCOME STATEMENTS

FIRST THREE YEARS OF OPERATION

Item	Year

CRIPPEN PIPE FABRICATION CORPORATION

PROJECTED BALANCE SHEETS

FIRST THREE YEARS OF OPERATION

Item	Year

CRIPPEN PIPE FABRICATION CORPORATION

CASH FLOW PROJECTION

FIRST THREE YEARS OF OPERATION

Item	Year

CRIPPEN PIPE FABRICATION CORPORATION

CASH FLOW PROJECTION

FIRST YEAR OF OPERATION

Item	Month

CRIPPEN PIPE FABRICATION CORPORATION

Notes on the Income Statements, Balance Sheets and Cash Flow Projections

CRIPPEN PIPE FABRICATION CORPORATION

BREAK - EVEN SALES LEVELS

FIRST THREE YEARS OF OPERATION

5. Analysis of Labor Productivity and Material Costs

CRIPPEN PIPE FABRICATION CORPORATION

CRIPPEN PIPE FABRICATION CORPORATION

VALUE OF DAILY SHOP PRODUCTION

The value of materials and the related charges for purchasing, handling and storage account for the major portion of the sales value of the normal company business. The ratio of material to labor costs used in the financial analysis is considered to be a general average for all types of projects. The ratio is important in determining working capital requirements and can vary widely from one project to another. Some companies, particularly the boiler manufacturers, purchase their own materials and simply purchase fabrication services with the materials supplied. The variation in material to labor is demonstrated by the following table showing the changes in ratio caused by changes in material type and wall thicknesses for a single configuration and pipe diameter. Greater variations could be demonstrated by varying the configuration and diameter.

The following table is most significant in its comparasion of the total cost of a hot bent pipe assembly with the same basic configuration using weld fitting. The cost savings using a hot bend in preference to weld fittings increases with increases in pipe thickness, pipe diameter and in instances where alloy pipe material is required. The letter from Sun Shipbuilding in Section II points up the sales potential of this cost savings.

CRIPPEN PIPE FABRICATION CORPORATION

MATERIAL AND LABOR COSTS
12" Diameter Pipe, 25' Long with a 90° Bend and One Weld

Material & Thickness	Material Cost	Labor Cost	Ratio	Total C
2-1/4 Chrome Stl, 2" thk.	$2,365	$1045	2.3	
Carbon Steel, 2" thk.	865	685	1.3	
2-1/4 Chrome Stl, Sch. 40-.406" thk.	555	353	1.6	
Carbon Stl., Sch. 40-.406" thk.	203	169	1.2	$372
Carbon Stl., Sch 40-.406" thk (90° weld ell fitting, 3 welds)	410	100	4.1	510
Cost Saving using hot bend construction				$138

CRIPPEN PIPE FABRICATION CORPORATION

VII. FINANCIAL STRUCTURE

CRIPPEN PIPE FABRICATION CORPORATION

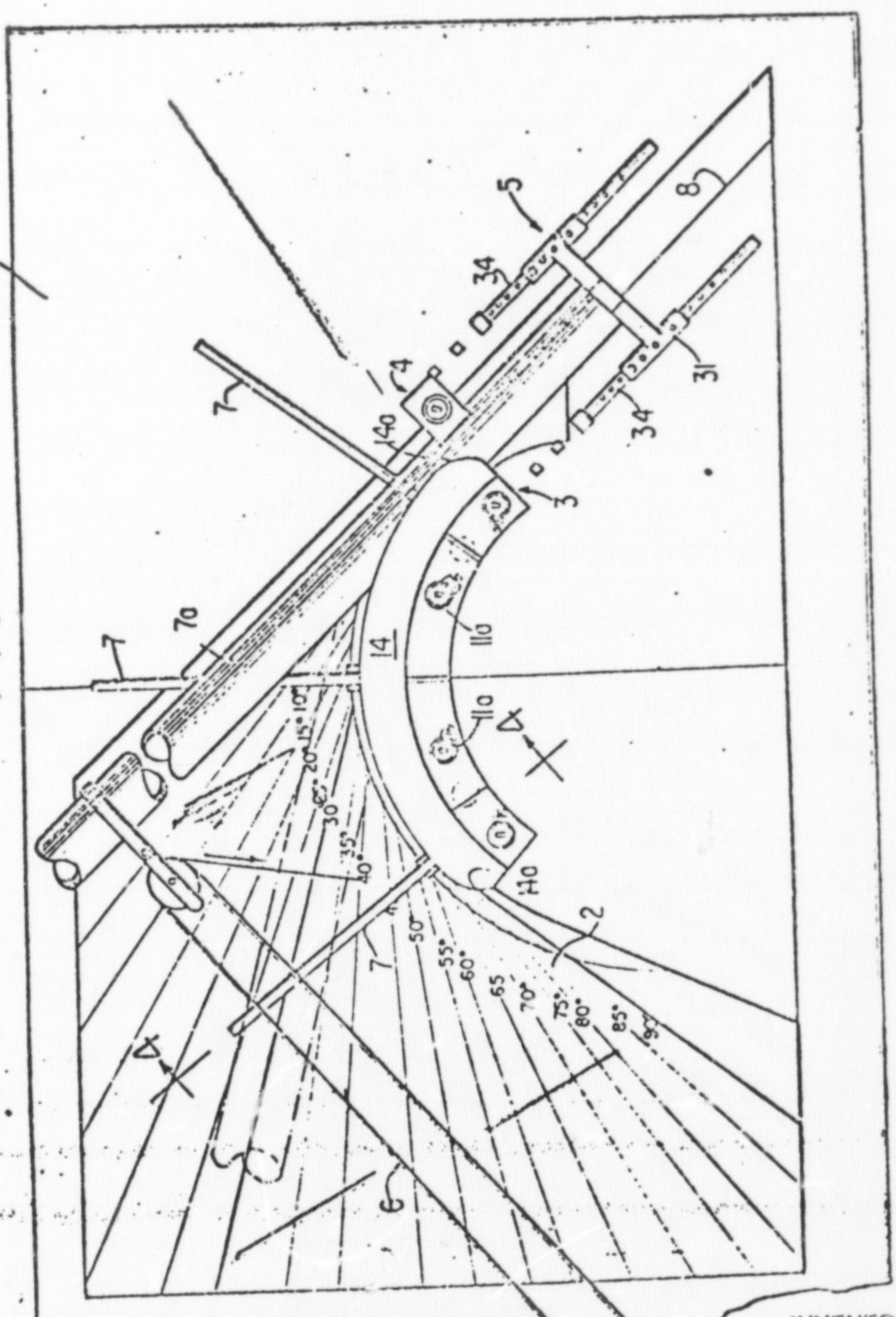
VIII. APPENDIX

July 22, 1969 H. O. CRIPPEN 3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet 1

FIG. 1

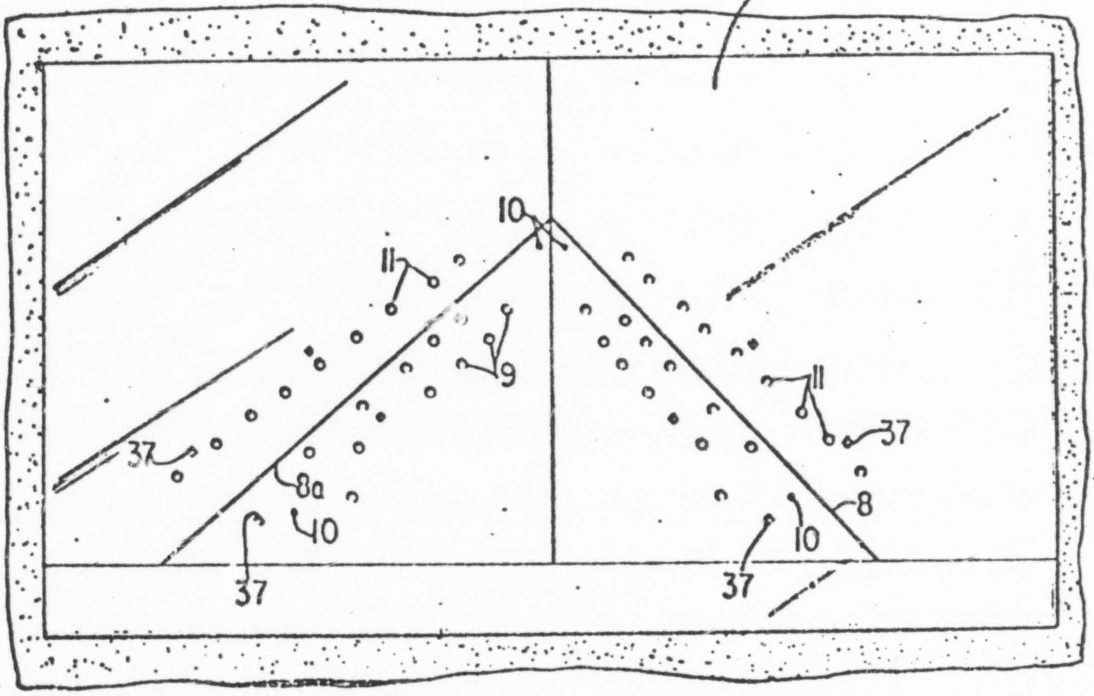


INVENTOR
HENRY O. CRIPPEN

BY
Hammond and Littell
ATTORNEYS

July 22, 1969 H. O. CRIPPEN 3,456,468
HOT PIPE BENDING APPARATUS AND METHOD
Filed March 28, 1967 5 Sheets-Sheet 2

FIG. 2



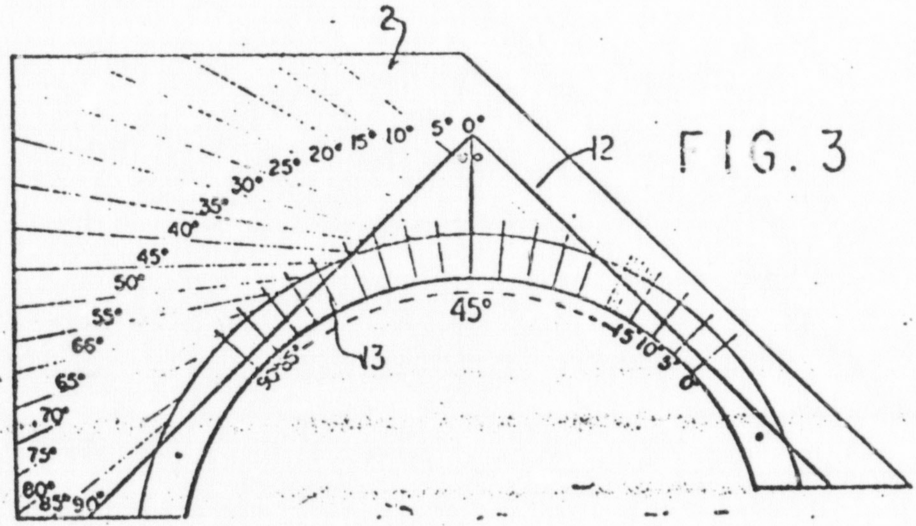


FIG. 3

INVENTOR
HENRY O CRIPPEN
BY
Hammond and Littell
ATTORNEYS

July 22, 1969 H. O. CRIPPEN 3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet

FIG. 5

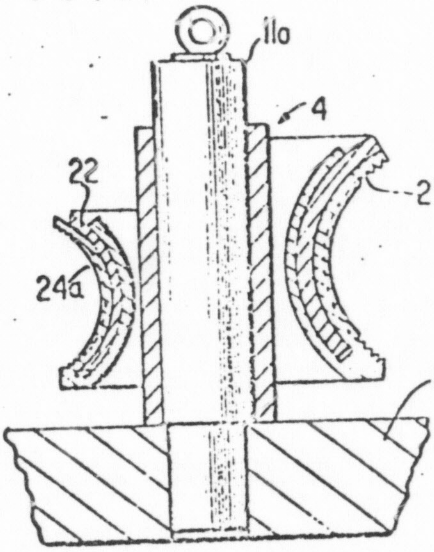


FIG. 6

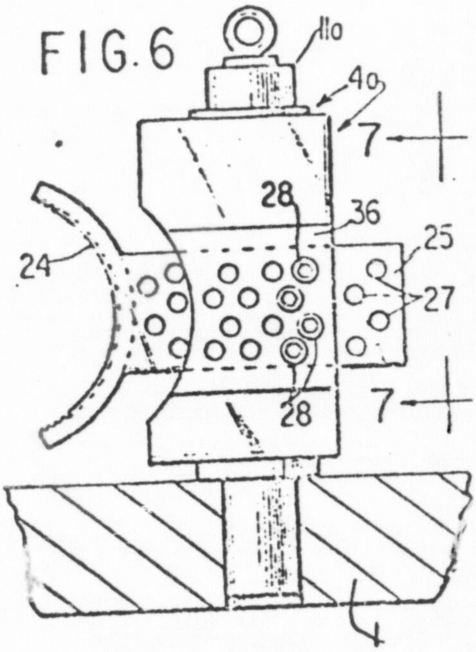
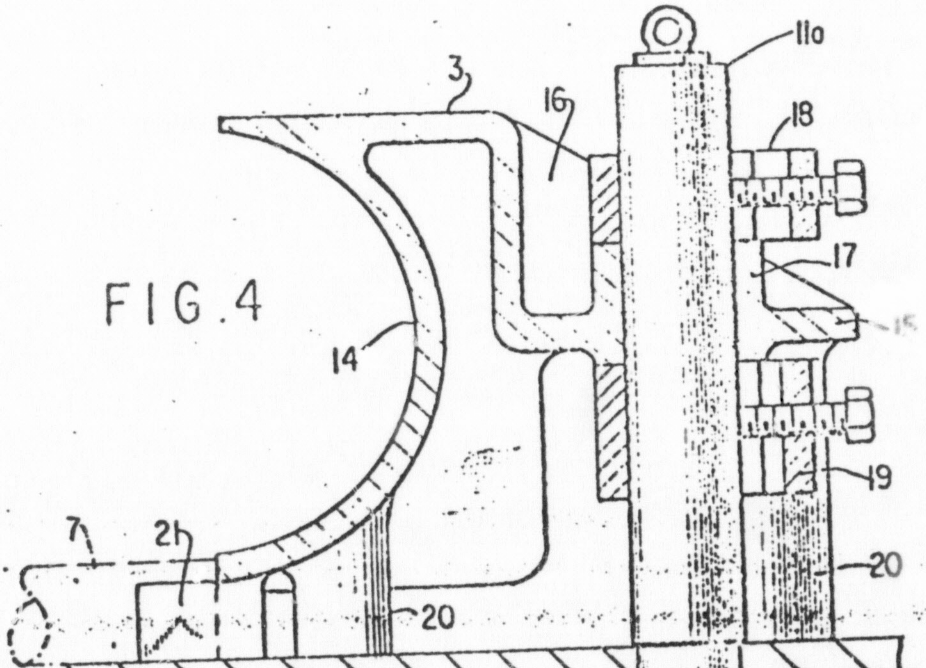


FIG. 4



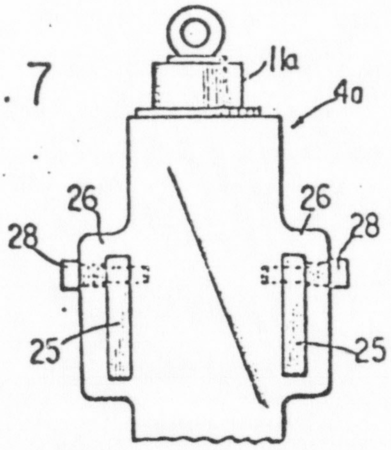
INVENTOR
HENRY O. CRIPPEN
BY
Hammond & Littell
ATTORNEYS

July 22, 1969 H. O. CRIPPEN 3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet 4

FIG.7



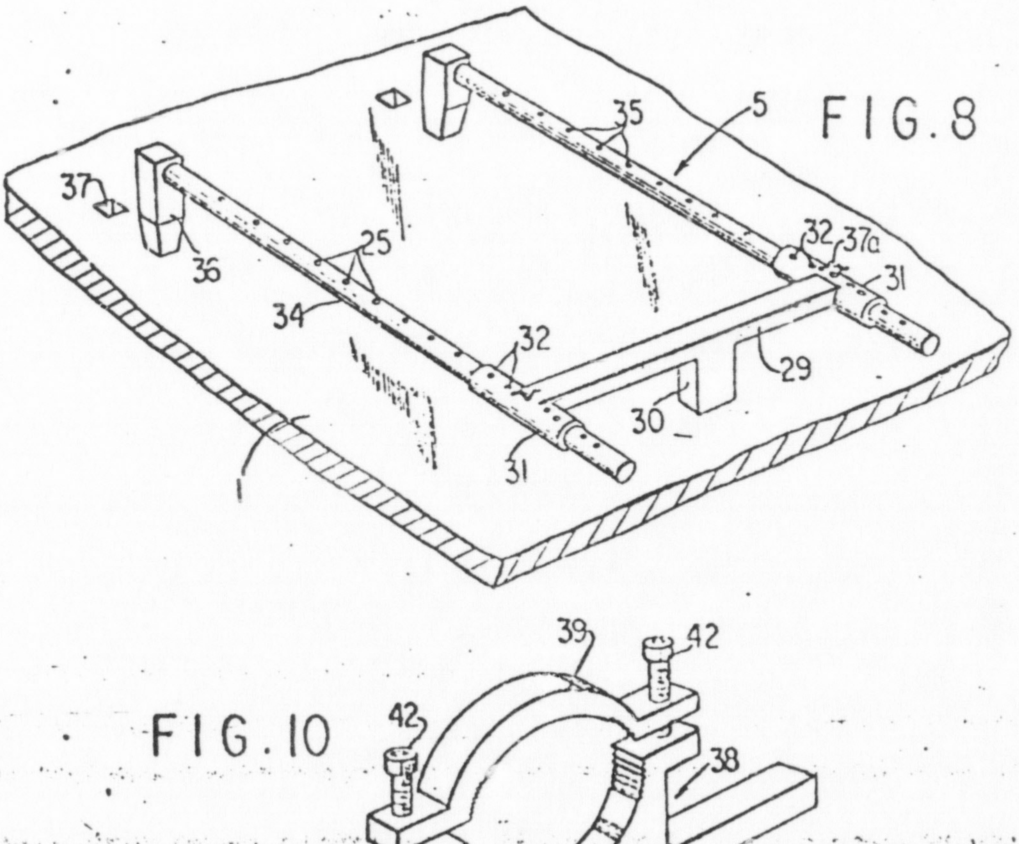
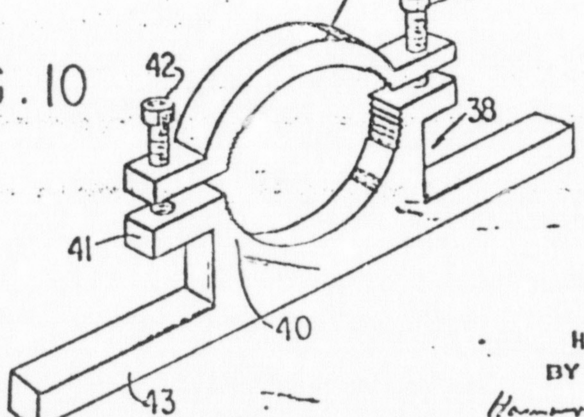


FIG.8

FIG.10



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July 22, 1969 H. O. CRIPPEN 3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet 5

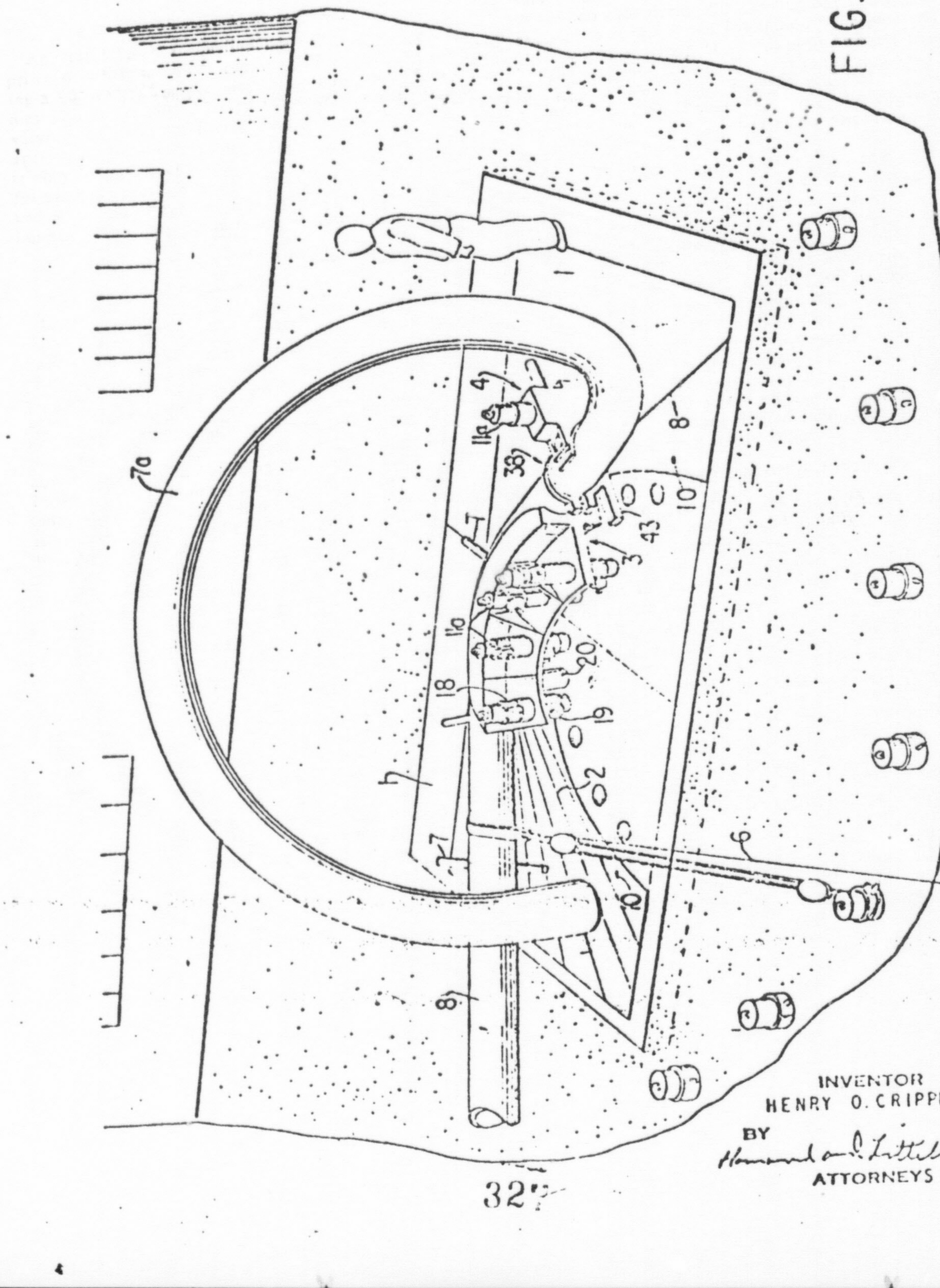

FIG.9

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Patented July 22, 1969

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3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

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Filed Mar. 23, 1967, Ser. No. 626,458
Int. Cl. B21d 9/05
U.S. Cl. 72—34 12 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for heat-bending large diameter pipe comprised of a bending block provided with guidelines forming a 90° angle, base template protractor, arced forming dies with about 180° grooved curvature face and having varying radii, means for holding one end of the pipe against the forming die during bending, means for maintaining the pipe level within the curvature face and means for applying pressure to bend the hot pipe about the die and a method of bending a hot pipe rapidly with a minimum of secondary operations and butt welding.

Prior art

Large diameter pipes are used in construction of many plants and buildings and for many installations they must be bent in specific ways in order to fit into the design conditions. Present methods of bending large diameter pipe have been costly due to the number of skilled men and the time required in the bending operation, the inaccuracy of the present system which results in waste of pipe or requires subsequent treatment by skilled personnel, and the difficulty in obtaining compound bends in a pipe. In the most common pipe-bending operations being used today, the pipe, which is filled with sand, is heated to a high temperature, i.e., 1500 to 2000° F., in a furnace and then set up on the bending table, which has a variety of holes therein. The starting end of the pipe is securely fastened and the portion of the pipe to be bent is without control of the angle of the bend and this portion rides free, resting on the bending table. The angle of the bend is controlled by the skill of the bender, by the use of a template, water and movement of the holding attachments and the angle of pulling leverage. The bending pressure is applied by a capstan with the use of several pulleys and a rope. The pulleys are held by stanchions. The rope is passed around the pulleys and connected to the pipe to be bent and the rope is then wrapped several times around the capstan. The bending pressure is started by tightening the rope around the revolving capstan and the bending pressure is relieved by releasing the rope. This operation is repeated until the desired angle of bend in the pipe is attained. During the operation of the bending, two men hold a template (usually a heavy wire bent to the desired angle of the bend) over the pipe to make certain the correct angle and radius of bend is obtained.

In addition to the men holding the template, a capstan operator and a man with a water hose are required. Water spraying of the hot pipe has two primary purposes: (1) to affect the radius of the pipe when the bend is closing in too sharply by spraying water on the outer side of the pipe to chill this portion of the pipe and stop or slow the bending in that portion, and (2) to prevent buckles in the pipe caused by the throat being too hot by spraying the inner side of the pipe with water. This operation requires not only four men and a great deal of time, but also a high degree of skill and experience. In addition, only clockwise or counterclockwise bends may be made on existing apparatus.

...l procedure has many disadvantages. One dis- ... f time required to per-

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pressure is required to bend the pipe the more it cools. For example, the tensile strength of one common pipe metal at 1600° F. is 10,000 pounds per square inch, while at a temperature of 1250° F., the same metal has a tensile strength of 35,000 pounds per square inch, an increase of 3.5 times in tensile strength over a temperatue drop of only 350° F. Under normal plant conditons, metal pipes will cool approximately 100° F. per minute and, therefore, the tensile strength of pipes and the pressure necessary to bend the pipes increases rapidly. If the pipe becomes too cold during the bending operation, too much pressure is required and flattening of the pipe walls occurs. Moreover, sharp or abrupt pulls on the pipe during bending thereof will cause thinning in the pipe walls which weakens the pipe. Faults caused by overbending, underbending, buckling, flattening or the like cause a high amount of rejects which increases the cost of pipe bending operations.

For proper bending, the outer side or heel of the pipe should be hotter, since the heel has to stretch and the inner side or throat of the bend only has to compress. When water is used to cool the inner side of the pipe, it will frequently cool one section of the throat of the pipe too much, which section becomes harder than the surrounding pipe sections and causes buckle. Thinning will occur due to uneven stretching and/or compression. If the throat of the pipe is unevenly cooled, the hotter portions of the throat will compress faster and cause buckles. If the far end of the pipe remains hotter than the portion of the pipe being controlled by the water, the pipe will bend farther ahead of the portion to be bent instead of following gradually the desired radius and the bend will not have the proper arc or radius.

Objects of the invention

It is an object of the invention to provide a novel apparatus for accurately and rapidly, bending large diameter pipe with small crews.

It is another object of the invention to provide a novel apparatus for bending large diameter pipe without the use of water for cooling.

It is a further object of the invention to provide a novel pipe bending apparatus which may be used for different size pipes to obtain bends up to 360° with varying radii and to obtain accurate compound bends in pipe.

It is another object of the invention to provide a pipe bending apparatus in which large diameter pipes may be bent clockwise or counterclockwise.

These and other objects and advantages of the invention will become obvious from the following detailed description.

The apparatus of the invention for bending large diameter pipes is comprised of a bending block provided with two guide lines forming a 90° angle and preferably provided with a plurality of holes therein; a base template protractor resting on the bending block marked off in degrees from ~~0~~ to 90° with the 0° line coinciding with one of the guide lines on the bending block and the 90° line coinciding with the other guide line on the bending block, an arced forming die, preferably having slightly more than a 90° arc, with a 180° grooved curvature face and have a radius substantially equal to the radius of the desired pipe bend, the said die being securely centered on the bending block so that the bottom lip of the forming die curvature at each end at 90° of this curvature face meets a guide line on the base template protractor at tangential points on the base template protractor, means for holding one end of the pipe to be bent against the forming die when laid along either guide line on the base template protractor, means for keeping

the pipe level during the bending operations, and pressure applying means to bend the pipe about the die the desired number of degrees.

The bending block is a rectangular steel block which is preferably made in two pieces for handling ease during construction thereof. The said block acts as a table upon which the hot pipe is bent and is set in the floor of the bending plant and is preferably level with the plant floor. On each side of the bending block at specified distances therefrom, holes are provided in the floor of the bending plant which accommodates stanchions which can be raised or lowered to provide for the positioning of the pressure applying means at a height so that the pipe is bent in a plane parallel to the floor. The angle of the applied pressure may be varied and clockwise and counterclockwise bends may be made by the proper selection of the stanchion.

The bending block is provided with two guide lines thereon which form a true 90° angle and these two guide lines provide a reference point layout for the bending block holes and for all of the equipment that fits thereon. Preferably, the bending block has a plurality of holes arranged along the two guide lines whereby forming dies may be secured with dowel pins passing down through dowel pin sleeves provided on the form plate of the forming die and engaging the holes in the bending block. The dowel pins in the holes secure each forming die in the proper relationship to the guide lines on the base template protractor. In a preferred embodiment, the bending block has 38 of the said holes positioned with respect to the angle formed by the guide lines to accept various sized forming dies for bending pipes of 6" to 18" diameter and the holding shoes. For bending of larger diameter pipes, i.e., up to 24" diameter, additional holes may be provided.

The holes in the bending block are arranged so that the center of the hot pipe, when it is in the forming die at the start of the bending operation, lies along one of the two guide lines. The forming die must be held securely in position on the bending block so that there is no movement thereof during the bending operation. The dowel pins and holes in the bending block provide the simplest method of securing the forming die without complicated attachments. For ease of handling, the dowel pins holding the forming die may be provided with eyehooks so that they may be removed from the holes in a simple fashion.

The base template protractor is secured on the bending block and fits around the base of the forming die. The said protractor is provided with degree lines from 0° to 90° at right angles to the radius of the forming die so that constant observation of the degree of the bend may be made during the entire bending process. The 0° line coincides with one guide line on the bending block upon which the hot pipe is laid at the start of the bending operation and the 90° line coincides with the other guide line. A second scale is preferably provided on the base plate protractor along the base of the curvature face of the forming die and coinciding with the center line of the pipe being bent and extends slightly beyond the outside diameter guide line. The 0° mark indicates the start of the bend in the pipe and the scale indicates the circular degree of the bend so that the exact position of the end of a bend can be marked on the pipe and a second bending operation may be effected, if necessary. The degree of the bend arc is the tangential point where the unbent portion of the pipe meets the forming die.

The base template protractor may also be provided with a concentrical guide line about the second scale which lies just outside the diameter of the bent pipe in the forming die. This line serves for checking the outside diameter of circular bends while they are still on the bending block. Preferably, the base template protractor faces, one face used for clockwise bending and the other face used for counterclockwise bending, depending upon its position on the bending block. A base template protractor is provided for each die to be used and each base template protractor coincides exactly with the two guide lines on the bending block whether it is used for clockwise or counterclockwise bending.

To secure the base template protractor in position, the bending block and the said protractor may be provided with cooperating holes so that dowel pins can pass through the template into the bending block. The said protractor provides a means for constantly observing the degree of the pipe bend from the start of the bend to the finished angle.

The forming die is an important feature of the invention since it provides a form about which the hot pipes can be bent without buckles or wrinkles or flattening or thinning of the pipe walls. The forming die is comprised of a die body having a grooved curvature face with a peripheral arc of 180° and a diameter slightly larger than the diameter of the pipe to be bent, a form plate centered along the entire back of the die body provided with sleeves to accommodate dowel pins which pass therethrough and engage holes in the bending block. Gussets between the back of the die body and the form plate may be provided for further strengthening of the die body. When the forming die is in position on the bending block, the bottom lip of the curvature face fits concentrically with the second scale of the base template protractor. Preferably, the ends of the top lip of the curvature face are elliptically shaped so that the hot pipe to be bent may be easily inserted into the forming die along the guide line and clamped into position rapidly.

The length of the die curvature for bending 18" diameter pipe is approximately 100 degrees in circumference. The dies for bending up through 18 inch diameter pipes may be varied from 100 degrees up to 180 degrees in circumference. The center of the forming die, when it is in position, should coincide with the middle of the 90° angle formed by the two guide lines on the bending block.

The curvature face of the forming die should be slightly elevated from the bending block so that the hot pipe in the bending position is slightly elevated to allow the pressure applying means to be attached to the hot pipe while keeping the hot pipe in a level plane. The curvature face and the form plate may, therefore, be provided with pedestals for their support. To support the hot pipe during the bending operations, a plurality of riding pipes or other means of the same height as the inside bottom lip of the curvature face are provided to keep the neutral axis of the pipe parallel to the neutral axis of the forming die. The riding pipes may be accommodated in recesses under the bottom lip of the curvature face and radiate from the curvature face.

The sleeves of the form plate of the die body are slightly larger in diameter than the dowel pins which engage the holes in the bending block. To take up the play between the said sleeves and the dowel pins, shims may be used. However, it is preferred to provide the sleeves at the top and bottom thereof with adjustable collars which can be hand tightened about the dowel pins to prevent movement of the die when bending pressure is applied to the pipe.

Means are necessary to hold one end of the hot pipe to be bent against the forming die in order to sustain the back pressure occurring when the hot pipe is pulled about the forming die to affect bending of the pipe. One suitable holding means when bending pipes up to 90° is a holding shoe having at least one curvature, preferably two, curvature faces on opposite sides, which are peripherally sufficient to support the outer side of the pipe. The said curvature faces may have a peripheral arc of approximately 90° and are offset from each other so

normally be in position to hold 12" diameter pipe. To hold different size pipes, the height of the neutral axis of the curvature face can be raised by spacer rings under the holding shoe so that the axis of the curvature face will lie in the same plane as the neutral axes of the forming die and the pipe. By this means, one curvature face can be used to hold pipes having 6" to 12" diameters and the other curvature face can be used to hold pipes having 12" to 18" diameters.

The holding shoe may be held in position by a dowel pin passing through the body of the holding shoe and engaging a hole in the bending block. This arrangement allows the holding shoe to be pivoted about the dowel pin so that the curvature face may be turned aside to allow more room for insertion or removal of the pipe from the forming dies. The holding shoe is positioned so that the pipe of a specific diameter is securely held in the forming die for that diameter. If odd size pipe is to be bent, i.e., a 9" diameter pipe in a 10" diameter forming die, the curvature face of the holding shoe may be provided with a correspondingly shaped shim insert to compensate for this difference in diameter.

While the said holding shoe is completely adequate for bends up to 90° in a pipe, difficulties arise with this shoe when bends of more than 90° are being made since the bent portion of the pipe to be held after the initial bend does not lie along the 0° guide line of the primary scale of the base template protracter but is concentrically aligned with the extended outside diameter guide line on the base template protractor. For this type of bending another holding shoe having a laterally adjustable curvature face is used.

This latter modification of holding shoe is provided with an adjustable extension arm on each side of the holding shoe which supports the curvature face whereby the curvature face can be moved laterally towards the pipe so that the pipe is held in conformity with the extended outside diameter guide line on the base template protractor. The neutral axis of the curvature face is offset from the middle of the holding shoe body so that the curvature face will be in position for holding 6" diameter pipe and when the holding shoe is inverted the curvature face will be in position for holding 12" diameter pipe. The said holding shoe may be raised with spacer rings for holding larger size pipes as with the previously described holding shoe.

The extension arms are preferably provided with 36 holes and the holding shoe is preferably provided with 12 holes on each side. The said holes are arranged so that 4 holes on each extension arm will coincide with 4 holes on each side of the holding shoe in varying positions so that 4 pins may be inserted through each side of the extension arm and the holding shoe to firmly hold the curvature face in the final position.

In a preferred embodiment of the apparatus, an adjustable stop means is provided for proper positioning of pipes when they are placed in the forming die for bending up to 90°. This stop means may be an adjustable stand rack with a stop-bar which acts as a backstop called a chock set. The stop-bar of the chock set may be slidably moveable along two channel tubes to provide for a plurality of bend tangents and is capable of being securely affixed thereto in any desired position. The forward ends of the channel tubes may be attached to square pegs which fit into square holes in the bending block to hold the chock set in position. The position of the stop-bar is preadjusted to stop the end of the pipe to be bent at the computed tangent dimensions so that the heated pipe will be aligned in the proper position for the start of the bend when inserted in the apparatus with its end abutting against the stop-bar.

In order to hold the pipe properly in position when making compound bends or second bends in circular bends, a position clamp is provided to prevent rotation of the pipe during the compound bending process, or to hold the pipe during the second bend of circular bends since the chock set is not used for these bends. This clamp may be made of two semi-circular parts which form a circular collar. Both circular parts are preferably provided with jagged teeth to clamp onto the pipe when the two parts are fastened together. The bottom semi-circular collar is provided with a base to prevent turning of both the pipe and clamp during the bending process. After the initial bend is put in the pipe, which is to have a compound bend put therein, the pipe is then put in the desired position in the forming die for the next portion of the bend. The position clamp is then placed about the pipe and firmly clamped thereto. The pipe may then be heated with the position clamp attached and re-inserted into the forming die so that the pipe can be rapidly aligned and no time for adjustment of the pipe is lost once the pipe is heated for the second portion of the compound bend. The height of the base of the position clamp should be such that the bottom semi-circular collar lies in the same plane as the inner bottom lip of the curvature face of the forming die so that the neutral axis of the pipe will be in the same plane as the neutral axis of the forming die curvature face.

The pipe bending apparatus of the invention has a wide variety of advantages, the most important of which are accurate rapid bending of pipes, whether simple, circular or compound bends or clockwise or counterclockwise or both, with a minimum of skill and number of men and equipment. The bending block provides a base for a large variety of setups for different bends. The base template protractor provides a simple means of constant observation of the angle of bend of the pipe.

The forming die due to its deep segmental curvature face provides a constant, protective support to the pipe along the entire portion of the pipe being bent thereby providing synchronization of the gradual stretching of the heel of the pipe and the compressing of the throat for proper following of the radius of the forming die. This prevents sharp abrupt pulls or bends and prevents thinning of the wall of the pipe. Since the pipe is never deviated from its bending course with the use of the forming die, the use of water on the pipe during bending is completely avoided and the disadvantages which occur with the use of water do not occur in the bending process. The forming die also extracts heat from the throat of the pipe and renders the inner side of the pipe cooler during the bending, which prevents the pipe from compressing too fast on its concave face. This coolness of the throat gives additional strength or stiffness, enabling it to resist creasing caused by the pressures put on it by the pull of the bend. This is advantageous since the heel or outer side of the pipe should be hotter during bending as it has a farther distance to travel and stretch while the throat has only to compress.

Another advantage of the apparatus of the invention is that bending may be done rapidly and little time is lost in positioning the pipe. This is important since pipes must be bent while hot and the longer the time between removal from the furnace and the completion of the bend, the more difficulties arise. The apparatus provides for an even bending pressure and the pipe follows the continued arc of the forming die which prevents the pipe from being bent sharply and prevents disruption of the compressing and stretching of the throat and heel of the bend. This lessens the chance of buckles that occur with the known methods of bending.

Referring now to the drawings:

FIG. 1 is a plan view of the pipe bending apparatus of the invention with the pipe in position for the start of the counterclockwise bend.

FIGS. 2 and 3 are plan views of the bending block and the base template protractor, respectively.

FIG. 4 is a cross-sectional view of the forming die of FIG. 1, taken along line 8—8.

FIG. 5 is a cross-sectional view of one holding shoe used to hold the pipe in position during bending.

FIG. 6 is a side view of an adjustable holding shoe used to hold the pipe in position when performing a bend of more than 90°.

FIG. 7 is a cross-sectional view of the holding shoe of FIG. 6, taken along line 7—7.

FIG. 8 is an enlarged view of the chock set of FIG. 1.

FIG. 9 is a view of another embodiment of the pipe bending apparatus of the invention during compound bending of a large diameter pipe.

FIG. 10 is an enlarged view of the position clamp of FIG. 1.

In the embodiment illustrated in FIG. 1, the pipe bending apparatus, ready to begin a bend, is comprised of bending block 1 set in the floor of the pipe bending shop, and provided with guide lines 8 and 8a which form a true 90° angle, approximately along the center line of the bending block, a base template protractor 2, forming die 3 centered on the 90° angle, holding shoe 4, chock set 5, block and tackle 6 attached to a winch (not shown), and riding pipes 7 which keep the pipe 7a level with the inner bottom lip of the forming die.

As can be seen from FIG. 2, the bending block 1 is provided with a series of holes 9 along guide lines 8 and 8a within the angle formed thereby which engage dowel pins 11a to secure forming dies for different diameter pipes to the bending block. The bending block is also provided with smaller holes 10 which engage pins to secure base template protractor 2 thereto and with holes 11 along guide lines 8 and 8a outside the angle formed thereby to engage dowel pins to secure the holding shoe 4 in various positions for different diameter pipes.

In FIG. 3, the base template protractor is shown as provided with two sets of degree markings from 0° to 90°. On the primary set 12 of degree markings, the 0° line coincides with guide line 8 of the bending block and the 90° line coincides with guide line 8a when the base template protractor is secured to the bending block. The degree lines of this scale radiate tangentially from the forming die so that the degree of the bend in the pipe can be easily observed throughout the bending. In the secondary set 13 of degrees, the 0° mark coincides with the portion of the forming die 3 at which the bend will start and runs radially to 90° with the 45° mark coinciding with the center of the 90° angle formed by guide lines 8 and 8a. The secondary scale 13 permits a bender to determine the radial degree at which a bend has stopped when bending more than 90°. The pipe 7a may then be marked where the bend stopped, be re-heated and reinserted into the die with the mark on the pipe aligned with the 0° mark of the secondary scale for the start of a second bend.

The forming die 3 as shown in FIG. 4 is comprised of a curvature face 4 ensuring that the heated portion of the pipe will be protected, form plate 15 secured to the back of curvature face 14 and gussets 16 which provide strength to the forming die. Form plate 15 is provided with sleeves 17 through which dowel pins 11a pass and engage holes 9 in bending block 1. The top and bottom of sleeves 17 are provided with adjustable collars 18 and 19 which firmly clamp the die body in position. The curvature face 14 and form plate 15 are provided with pedestals 20 to support the forming die, and to elevate the curvature face slightly above the surface of the bending block so that the block and tackle 6 may be attached to pipe 7a during the bending without changing the plane of the bend. The top of riding pipes 7 coincides with the inner bottom lip of curvature face 14 and is held in position by brackets 21. As shown in FIG. 1, the outer edges 14a of the upper lip of curvature face 14 are elliptically shaped so that pipe 7a may be positioned directly on guide line 8 without hitting the forming die. Holding shoe 4 is provided with two curvature faces 22 and 23 which are provided with jagged teeth to firmly grip the pipe. The arc of the said curvature faces is approximately 90°. Curvature face 22 is positioned so that the bottom lip thereof is elevated above the bending block slightly higher than the riding pipes 7 so that it may be used to hold small diameter pipes, i.e. 6" to 12", while the curvature face 23 is more elevated above the bending block to hold larger diameter pipes, i.e., 12" to 18". The neutral axis of the forming die curvature face to be used is precisely in the same plane as the neutral axes of the pipe to be bent and the curvature face of the holding shoe. To accommodate odd size pipes, i.e., 9" diameter, the curvature faces of the holding shoe may be provided with a shim 24a to take up the difference.

Holding shoe 4a of FIGS. 6 and 7 is especially useful for compound bending and in putting a second bend in a circular bend since the curvature face 24 can be moved laterally to engage the bent portion of the pipe which will not lie along guide line 8. The curvature face 24 is held on either side by extension arms 25 which slide in slots 26 of the holding shoe.

The extension arms 25 are provided with 4 rows of 9 holes, 27, while the body portion of the holding shoe is provided with 4 rows of 3 holes in each, which are arranged so that 4 holes in extension arms 25 will correspond with 4 holes in the body of the holding shoe, so that the distance between curvature face 24 and the holding shoe body can be varied in 1" increments. The extension arms are held firmly in position by pins 28 which pass through the 4 aligned holes in the extension arms and the holding shoe body.

The chock set, shown in detail in FIG. 8, is used so that the portion of the pipe where the bend is to start will be aligned with the 0° mark on the secondary scale of the base template protractor when the end of the pipe 7a is abutting against the chock set 5. The chock set is comprised of a stop-bar 29 provided with a pedestal 30 in the center thereof and with tubular collar sleeves 31 at either end thereof, which sleeves have a plurality of holes 32 drilled therethrough. Passing through each of collar sleeves 31 is an extension channel tube 34 provided with a plurality of holes 35 drilled therethrough and with a square pin at the end thereof to hold the channel tubes parallel to the bending block at the same height as the stop-bar 29. The square pins 36 engage square holes 37 in the bending block in order to hold the chock set in position. The stop-bar 29 can be moved along the length of channel tubes 34 to the desired position and secured therein by passing pins 37a through the holes in the collar sleeves and in the channel tubes.

To bend a pipe, a forming die with a curvature face of the desired radius and diameter and its base template protractor are secured to the bending block with dowel pins 11a. Holding shoe 4 is positioned on bending block 1 with its curvature face turned aside from the forming die 3. To bend a pipe up to 90° with the apparatus of the invention, the length of the arc of the bend is marked off on the pipe 7a where the bend is to begin and to end. The die 3 and base template protractor 2 for this bend radius and diameter of pipe is positioned on the bending block 1 with the inner side of the base template protractor adjoining the bottom lip of the curvature face of the forming die and the holding shoe 4 is positioned in the proper hole in the bending block 1 for the diameter of the pipe 7a. The chock set 5 is preadjusted so that the butt of the pipe 7a will abut against stop-bar 29 with the beginning of the bend marked on the pipe 7a coinciding with the 0° mark on the secondary scale 13 of the base template protractor 2. The pipe 7a is then heated to the proper temperature in a furnace and brought to the bending apparatus. The pipe is laid along guide line 8

pressure is applied. The block and tackle 6 is attached to the end of the pipe 7*a* and the winch is started to bend the pipe about the curvature face of the forming die and the desired number of degrees.

Although FIG. 1 illustrates the bend as starting from the right side of the bending block, the holding shoe 4 and chock set 5 may be located at the left side of the bending block and the bend can be made from the left side to the right side of the bending block.

FIG. 9 illustrates the apparatus of the invention putting the third bend in a compound bend in a pipe 7*a*. The chock set is not used since the end of the pipe does not end along guide line 8. The portion of the pipe 7*a* where the bend is to begin is marked on the pipe and position clamp 38 is attached to the pipe to prevent the pipe from twisting or turning during bending.

As can be seen from FIG. 10, position clamp 38 is comprised of an upper semi-circular collar 39 and a lower semi-circular collar 40 provided with lugs 41 having threaded holes so that the two halves of the clamp can be securely held together by bolts 42. The inner surfaces of the semi-circular collars are preferably jagged to ensure firm gripping of the pipe. Bottom semi-circular collar 40 is provided with a base 43 extending out on either side thereof which prevents twisting of the position clamp and pipe during bending.

Various modifications of the apparatus and method of the invention may be made without departing from the spirit or scope thereof and it is to be understood that the invention is to be limited only as defined in the appended claims.

I claim:

1. An apparatus for hot bending large pipes of at least 6" diameter comprised of a bending block provided with two guide lines forming a 90° angle; base template protractors to rest on the bending block provided with a primary scale marked off in degrees from 0 to 90° with the 0° line coinciding with one of the guide lines on the bending block and the 90° line coinciding with the other guide line on the bending block and a secondary scale with a scale from 0° to 90°, arced forming dies having approximately 180° grooved curvature faces and a radius equal to the radius of the desired pipe bend, the said die being securely centered on the bending block within the 90° angle formed by the primary scale and with the bottom lip of the forming die curvature face coinciding with the secondary scale of the base template protractor, means for holding one end of the pipe to be bent against the forming die when laid along either guide line on the base template protractor, means for keeping the pipe level with the curvature face of the forming die and pressure applying means to bend the hot pipe about the die the desired number of degrees.

2. The apparatus of claim 1 wherein the bending block is provided with a plurality of holes which cooperate with dowel pins to secure the base template protractor, the forming die and the holding means in position.

3. The apparatus of claim 1 having an adjustable stop means against which the hot pipe abuts during bending whereby the portion of the pipe where the bend starts coincides with the 0° mark on the secondary scale of the base template protractor with the pipe abutting against the said stop means.

4. The apparatus of claim 1 wherein the arc of the forming die is approximately 100°.

5. The apparatus of claim 1 wherein ends of the upper lip of the curvature face of the forming die are elliptically shaped whereby the pipe to be bent can be directly inserted between the holding means and the forming die.

6. The apparatus of claim 1 wherein the holding means is provided with at least one curvature face having an arc of approximately 90° and means for adjusting the height of the said curvature face so that the neutral axis of the curvature face will lie in the same plane as the neutral axis of different diameter pipe and forming dies.

7. The apparatus of claim 6 wherein the holding means is provided with two curvature faces on opposite sides thereof with one face being closer to the bending block than the other curvature face whereby the curvature faces will hold different diameter pipes.

8. The apparatus of claim 1 wherein the means for keeping the pipe level with the curvature face of the forming die are riding pipes radiating out from the die at a height level with the bottom lip of the forming die curvature face.

9. The apparatus of claim 1 for bending pipes more than 90° wherein the holding means is provided with a laterally adjustable curvature face having an arc of approximately 90° and means for adjusting the height of the said curvature face so that the neutral axis of the curvature face will lie in the same plane as the neutral axis of different diameter pipe and forming dies.

10. The apparatus of claim 1 provided with means for clamping the pipe whereby the pipe is held in position to prevent twisting and turning of the pipe during compound bending.

11. The method of bending large pipes of at least 6" diameter which comprises heating the pipe to the bending temperature, anchoring one end of the pipe and bending the pipe in a horizontal plane the desired number of degrees around the curvature faces of a continuous arced forming die which at the bending point extends approximately 180° around the pipe circumference and the radius of the arc is equal to the radius of the bend to be made and is spaced from the bending floor.

12. The method of claim 11 in which the pipe being bent rests upon riding supports which support the pipe spaced from the bending floor substantially the same distance the bending die is spaced from said floor.

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CHARLES W. LANHAM, Primary Examiner

LOWELL A. LARSON, Assistant Examiner

U.S. Cl. X.R.

72—342, 388

PIPE FABRICATION INSTITUTE PUBLICATIONS

STANDARDS

ES1—End Preparation and Machined Backing Rings for Butt Welds (November 1966) $1.00
ES2—Method of Dimensioning Piping Assemblies (August 1967) $1.00
ES3—Fabricating Tolerances-Minimum Bending Radii-Minimum Tangents (November 1965) $1.00
ES4—Shop Hydrostatic Testing of Fabricated Piping (August 1967) $1.00
ES5—Cleaning Fabricated Piping (September 1962) $1.00
ES7—Minimum Length and Spacing for Welded Nozzles (September 1962) $1.00
ES8—Preheat and Postheat Welding Practices for Low Chromium-Molybdenum Steel Pipe (March 1964) $1.00
ES9—Shielded Metal-Arc Welding Dissimilar Ferritic Steels (May 1964) $1.00
ES10—Stress Relieving Welded Attachments (April 1964) $1.00
ES11—Permanent Identification of Piping Materials (August 1968) $1.00
ES12—Preheat and Postheat Welding Practices for Medium Chromium-Molybdenum Steel Pipe (March 1964) $1.00
ES13—Classification of Shop Testing, Inspection and Cleaning (August 1964) $1.00
ES14—Magnetic Particle Inspection (April 1964) $1.00
ES15—Recommended Radiographic Interpretation of Tungsten Inert Gas Welds (April 1962) $1.00
ES16—Access Holes and Plugs for Radiographic Inspection of Pipe Welds (April 1962) $1.00
ES17—Liquid Penetrant Inspection (April 1962) $1.00
ES18—Ultrasonic Inspection of Seamless Piping (October 1962) $1.00
ES19—Heat Treatment of Ferrous Pipe Welds (September 1964) $1.00
ES20—Wall Thickness Measurement of Pipe Bends by Ultrasonic Resonance Inspection (September 1964) $1.00
ES21—End Preparation for Manual Inert-Gas Tungsten-Arc Root-Pass Welding (August 1967) $1.00

TECHNICAL BULLETINS

TB1—1968 Pressure-Temperature Ratings of Seamless Pipe Used in Power Plant Piping Systems $3.00

TB2—1956 Pressure Ratings for 90° Unreinforced Branch Connections of Seamless Steel Pipe $1.00

TB3—1963 Guide Lines Clarifying Relationships and Design Engineering Responsibilities Between Purchasers' Engineers and Pipe Fabricator or Pipe Fabricator Erector (June 1963)

PIPE FABRICATION INSTITUTE MEMBERSHIP

Corbett Fabricating Company, Inc.
Houston, Texas

Cornell & Underhill, Inc.
Hoboken, New Jersey

Dravo Corporation
Marietta, Ohio

Grinnell Company, Inc.
Providence, Rhode Island

Fabricating Division
Chas. F. Guyon, Inc.
Harrison, New Jersey

Hoover Fabricators, Inc.
La Marque, Texas

The M. W. Kellogg Company
Power Piping Division
Williamsport, Pennsylvania

The Macander Corporation
Buffalo, New York

National Valve and Manufacturing Co.
Pittsburgh, Pennsylvania

Nelson Company
Holmes, Pennsylvania

Piping Engineering Company
Tulsa, Oklahoma

Power Piping Company
Pittsburgh, Pennsylvania

Alex Robertson Company
Paramount, California

Scott Co. of California
Oakland, California

Benjamin F. Shaw Company
Wilmington, Delaware

Southwest Fabricating & Welding Co., Inc.
Houston, Texas

Stearns-Roger Corporation
Denver, Colorado

Taylor Engineering Corporation
Detroit, Michigan

Texas Pipe Bending Co., Inc.
Houston, Texas

Tubeco Inc.
Brooklyn, New York, N. Y.

Western Piping & Engineering Co. Inc.
San Francisco, California

CRIPPEN PIPE FABRICATION CORPORATION

BABCOCK & WILCOX/HENRY CRIPPEN AGREEMENT

On the following pages you will find a copy of the proposed agreement between Henry Crippen and Babcock & Wilcox, the major manufacturers of power and industrial products.

This agreement was not consummated because Babcock & Wilcox encountered unusual sales losses of $50 million and therefore decided not to undertake this modernization program.

The agreement is enclosed to provide a yardstick for the valuation of the patented process developed by Henry Crippen.

Babcock & Wilcox

Power Generation Division

Barberton, Ohio 44203
Telephone: (216) 753-4511

November 21, 1968

H. O. Crippen
P. O. Box 217
Morrisania Station
Bronx, New York 10456

Re: N.I. 11546 apparatus and method of hot bending large O.D. pipe

Dear Mr. Crippen:

We wish to thank you for your fine presentation of your method of hot bending pipe. The demonstration was very enlightening to our people and we are very interested in your pipe bending method.

We are proceeding to evaluate your method and apparatus in comparison to our present method to determine the benefits of a change. We expect to complete our evaluation in approximately four (4) weeks and will inform you of the results.

If in the course of this evaluation we should require more details concerning your apparatus and methods, we will contact you for this information.

We ask that during the time required for our evaluation you do not contact anyone else for the purpose of disposing of your method and patent rights.

We thank you again for visiting us and for your fine demonstration.

Sincerely,

THE BABOCK & WILCOX COMPANY

E.C. Kingsland

E. C. Kingsland
Industrial Engineering

ECK/kkm

BCOCK & WILCOX COMPANY
GENERATION DIVISION

MEMO TO FILE

BDS 663-4

m R. GARDNER - PRODUCT ANALYSIS, INDUSTRIAL ENGINEERING

t.

File No. or Ref. 4A39x12

Date NOVEMBER 21, 1968

bj. N1-11546 APPARATUS AND METHOD OF HOT BENDING LARGE O.D. PIPE

This letter to cover one customer and one subject only.

A meeting was held in the Better Methods Class Room on November 19, 1968, at 1:30 P.M. In attendance were messrs.:

H. O. Crippen	-	Inventor
R. Gardner	-	Industrial Engineering
W. G. Garrison	-	Industrial Engineering
E. C. Kingsland	-	Industrial Engineering
R. L. King	-	Industrial Engineering
J. L. Klosterman	-	Manufacturing
G. F. McDermott	-	Manufacturing
R. L. McInnes	-	Industrial Engineering
F. M. Munka	-	Manufacturing
M. W. Peterson	-	Manufacturing
E. H. Sellers	-	Manufacturing
C. J. Sagos	-	Manufacturing
F. E. Winkler	-	H. O. Crippen's attorney
J. B. Ujvari	-	Industrial Engineering

The purpose of the meeting was to allow H. O. Crippen to demonstrate his novel method of bending large O.D. pipe and his patented apparatus.

The apparatus consists of a large base plate laid out with reference lines and drilled with holes in a pattern to accommodate the set up of various sized formers, shoes, end chocks, etc. A protractor template is used to indicate and check the degree of bend. He also showed a model of a side loading furnace that would allow for the heating of more than one pipe at a time. This furnace while not a patented item was considered by H. O. Crippen as essential for the success of the method.

It was very apparent that the largest saving in Mr. Crippen's method over our metho of bending large O.D. pipe is not in the actual bending time, but in the eliminatio or reduction of other operations. The proposed method would apply to approximately 80% of our hot bending of large O.D. pipe and we would realize the following tangib benefits plus a possibility of several intangibles.

1. By accurate bending with H. O. Crippen's apparatus, it will not be necessary to check and set the pipe after bending.

2. By being able to accurately make compound bends, we can weld tubes together in the straight using automatic sub arc and bend the pipe to the required configuration. This eliminates fitting and manual welding to make a tube assembly.

3. By being able to accurately locate the bend tangents in reference to the pipe ends, we can make the weld prep on the ends of straight pipe and then make the bend. This eliminates much layout and the making of weld preps on the ends of the bent pipe.

One of the intangibles is the fact that certain pipe O.D.'s and wall thicknesses ca be bent without sand filling but at this time H. O. Crippen would rot reveal to wha extent this could be done.

We are proceeding to evaluate the tangible benefits of this method in direct comparison with our present method in order to gather information to determine the value of Mr. Crippen's method and apparatus.

E. C. Kingsland

E. C. Kingsland

ECK/kkm

cc: P. G. Ashley
W. D. Bolich
A. T. Fragomen
J. P. McNally
Those Listed

Babcock & Wilcox

161 East 42nd Street, New York, N.Y. 1001
Telephone: (212) 687-6700

July 8, 1969

Mr. Frederick E. Winkler
Bisco, Winkler & Higgiston
29 Broadway
New York, New York 10006

Re: Henry O. Crippen
Agreements

Dear Mr. Winkler:

We are enclosing duplicate copies of three agreements. One agreement relates to the option, the second agreement relates to the purchase of the Crippen patent and the third agreement relates to a consulting arrangement with Mr. Crippen. These agreements have been approved in our organization and are being submitted to you for your comments and suggestions.

Will you please consider the content of these papers and let us have your comments at your convenience.

Very truly yours,

THE BABCOCK & WILCOX COMPANY

E A Mosley

E. A. Mosley
Patent Department

EAM/bt
Enclosures

6/3/69

Exhibit A

PURCHASE AGREEMENT

Memorandum of AGREEMENT made and entered into this ____________ day of ________________, 1969, by and between THE BABCOCK & WILCOX COMPANY (hereinafter "B&W"), a corporation of New Jersey having a place of business at 161 East 42nd Street, New York, New York, and HENRY O. CRIPPEN (hereinafter "CRIPPEN"), a resident of

WITNESSETH THAT:

WHEREAS, B&W and CRIPPEN have entered into Option and Consultant Agreements regarding the construction and testing of CRIPPEN's system for pipe bending, and governing the rights and duties of the parties during the life of such agreements; and

WHEREAS, CRIPPEN heretofore made a certain invention in APPARATUS FOR AND A METHOD FOR HOT PIPE BENDING for which he had made application for Letters Patent for the United States under Serial No. 626,458, Filed March 28, 1967 and,

WHEREAS, B&W is desirous of acquiring the entire right, title and interest in, to and under the aforesaid invention, such modifications thereof and improvements thereon as CRIPPEN hereafter will make, and such patent and patents which have been or may hereafter be granted thereon in the United States of America and in foreign countries.

NOW, THEREFORE, for and in consideration of the premises and the covenant hereinafter recited to be faithfully performed and the sum of One Hundred Thousand Dollars ($100,000.00) by B&W to CRIPPEN in hand paid, the receipt of which is hereby acknowledged, it is understood and agreed, as follows:

6/3/69

(1) CRIPPEN covenants that he is the sole and exclusive owner of the aforesaid invention, and application covering the same and that he has full right to enter into this AGREEMENT.

(2) CRIPPEN hereby sells, assigns, transfers and sets over to B&W, his entire right, title and interest in, to and under the aforesaid invention, any and all modifications thereof and improvements thereon that he may hereafter make and any and all Letters Patent that may hereafter be granted therefor in the United States of America and in all foreign countries where B&W shall elect to secure patent protection; provided, however, CRIPPEN shall have and hereby retains a license to make or have made and use the invention disclosed and claimed in said U. S. Patent application, Serial Number 626,458; said license, however, is personal and may not be assigned or otherwise transferred to any other party without the written consent of B&W.

(3) CRIPPEN shall execute all papers that may be necessary or desirable to enable B&W or its nominee or nominees to file and prosecute applications for Letters Patent in all countries in which B&W shall elect or be able to secure patent protection for said inventions, modifications and improvements, and shall also execute all papers that may be necessary or desirable to vest in B&W or its nominee or nominees the entire right, title and interest in, to and under the aforesaid inventions, modifications and improvements and the Letters Patent that have issued or may issue thereon in all countries in which B&W elects to secure patent protection.

(4) B&W agrees that any licenses granted to others under the invention disclosed and claimed under Serial Number 626,458, will be royalty bearing; and that 15% of royalties collected under such

6/3/69

licenses will be paid to CRIPPEN.

(5) B&W agrees to keep true and complete books of account accurately showing its operations under this agreement, and CRIPPEN or his duly authorized representatives, shall have access thereto at all reasonable times during business hours in order to verify the accuracy thereof or of any report furnished by B&W to CRIPPEN.

(6) B&W agrees to render to CRIPPEN on or before the 15th day of February, May, August and November in each year during the term of this agreement, a statement covering all licenses granted under item 5 during the last day of the preceding December, March, June and September respectively setting forth:

(a) the number of installations licensed together with the name of each licensee, the location of each installation, and the royalty rate on each installation.

(b) the total amount of royalty received by B&W from each licensee, and the amount of royalty paid or payable to CRIPPEN.

(c) the total amount of royalty due and not received by B&W, together with the name of the licensee and the location of such installation.

B&W agrees to accompany such quarterly statements with a check or checks payable to CRIPPEN covering the net royalty payments payable to him for the preceding quarter.

(7) B&W and CRIPPEN agree that any controversy or claim arising out of or relating to this agreement, or the breach thereof, shall be settled by arbitration in accordance with the Rules of the American Arbitration Association.

This agreement shall be interpreted under the laws of the State of New York.

6/3/69

(8) Any notice or request given under this agreement shall be deemed to have been sufficiently addressed when if given to CRIPPEN, it shall be addressed to:

and when given to B&W, it shall be addressed to:

Secretary,
The Babcock & Wilcox Company
161 East 42nd Street
New York, N.Y. 10017

and in either case sent by registered or certified mail. The date of mailing shall be deemed to be the date on which such notice or request has been given. Either party may give written notice of a change of address and, after notice of such change has been received, any notice or request shall thereafter be given to such party as above provided at such changed address.

IN WITNESS WHEREOF, CRIPPEN and B&W have duly executed this agreement, B&W under seal and has caused it to be duly executed in its name by its proper officers thereunto duly authorized.

THE BABCOCK & WILCOX COMPANY

______________________	______________________
By: ______________________	By: ______________________
Witnessed:	Witnessed:
______________________	______________________

6/3/69

OPTION AGREEMENT

THIS AGREEMENT entered into as of this _________ day of _______________________, 196 , by and between HENRY O. CRIPPEN, a resident of _____________________________(hereinafter "CRIPPEN"), and THE BABCOCK & WILCOX COMPANY, a New Jersey corporation, having its principal place of business at 161 East 42nd Street, New York, N.Y. (hereinafter "B&W");

WITNESSETH, THAT:

WHEREAS, CRIPPEN has heretofore made an invention in "Apparatus For and a Method For Hot Pipe Bending" for which he has made application for Letters Patent for the United States under Serial Number 626,458, filed March 28, 1967; and

WHEREAS, CRIPPEN covenants that he is the sole and exclusive owner of said patent application, Serial Number 626,458, and that he has full and exclusive right to enter into this agreement and the purchase agreement attached hereto as Exhibit A.

WHEREAS, B&W is a leading manufacturer of steam generating equipment which involves the bending of pipes; and B&W is desirous of acquiring all of CRIPPEN's Knowhow relating to or useable in the design, construction and operation of equipment for bending pipes, with a view to building and operating such equipment and implementing said purchase agreement in the event equipment operation satisfies B&W's requirements.

NOW, THEREFORE, in consideration of the payment of One Dollar ($1.00) by B&W to CRIPPEN, the receipt of which is hereby acknowledged, and other good and valuable considerations, the parties have mutually agreed as follows:

6/19/69

(5) Secrecy

B&W agrees to hold in confidence any and all Knowhow disclosed by CRIPPEN, directly or indirectly, in writing or, if oral, subsequently confirmed in writing, to B&W by CRIPPEN under this agreement, except:

(a) technical information which at the time of disclosure is in the public domain;

(b) technical information which, after disclosure, is published or otherwise becomes part of the public domain through no fault of B&W (but only after it is published or otherwise becomes part of the public domain);

(c) technical information which B&W can show was in its possession at the time of disclosure and was not acquired, directly or indirectly, from CRIPPEN or from a third party under an obligation of confidence with CRIPPEN; and

(d) technical information which B&W can show was received by it after the time of disclosure hereunder from a third party who did not require B&W to hold it in confidence and who did not acquire it, directly or indirectly, from CRIPPEN.

Nothing contained in this Article shall deny B&W the right to use technical information received from a third party; provided, however, that such information was not obtained by said third party, directly or indirectly, from CRIPPEN.

(6) Agreement Not Assignable

Neither this agreement nor any of the rights and powers created herein may be assigned, in whole or in party, by either party hereto without the written consent of the other party first obtained.

(7) Disputes and Interpretations

CRIPPEN and B&W agree that any controversy or claim arising out of or relating to this agreement, or the breach thereof, shall be settled by arbitration in accordance with the Rules of the

6/19/69

(1) Option Grant

CRIPPEN agrees to grant and hereby grants to B&W a sole and exclusive option, for a period ending three years from the date hereof, or ending after one year of operation of said equipment, whichever occurs sooner, to acquire the rights set forth in "Exhibit A".

(2) Payments by B&W to CRIPPEN

B&W agrees to pay to CRIPPEN the sum of Seven Thousand Five Hundred Dollars ($7,500.00), which shall be paid on the date of execution of this agreement.

(3) Test Program

(a) To determine the value of the CRIPPEN pipe bending concept, B&W agrees to conduct or have conducted at a location selected by B&W a test program involving the fabrication, erection and operation of pipe bending equipment in accordance with CRIPPEN's Knowhow and embodying his concept for pipe bending disclosed in the aforesaid application. The test program shall be under the management of B&W.

(b) During the entire test program CRIPPEN shall provide consulting services to B&W in accordance with the terms of the "Consultant Agreement" attached hereto as "EXHIBIT B".

(4) Foreign Patent Applications

B&W shall bear the expense of filing and prosecuting applications for Letters Patent in countries foreign to the United States of America, corresponding to said patent application Serial Number 626,458 as it may elect, and to bear the expense of maintenanc[e] of all such Letters Patent in such elected countries during the optio[n] period and thereafter if B&W exercises the option covered by this agreement. If B&W does not exercise such option, then CRIPPEN will assume the responsibility and charges involved in the prosecution and/or maintenance of said foreign applications and/or patents.

6/3/69

American Arbitration Association.

This agreement shall be interpreted under the laws of the State of New York.

(8) Address

Any notice or request given under this agreement shall be deemed to have been sufficiently addressed when if given to CRIPPEN, it shall be addressed to:

and when given to B&W, it shall be addressed to:

Secretary,
The Babcock & Wilcox Company
161 East 42nd Stre t
New York, N.Y. 10017

and in either case sent by registered or certified mail. The date of mailing shall be deemed to be the date on which such notice or request has been given. Either party may give written notice of a change of address and, after notice of such change has been received, any notice or request shall thereafter be given to such party as above provided at such changed address.

IN WITNESS WHEREOF, CRIPPEN and B&W have duly executed this agreement, B&W under seal and has caused it to be duly executed in its name by its proper officers thereunto duly authorized.

THE BABCOCK & WILCOX COMPANY

______________________ ______________________

By:______________________ By:______________________

Witnessed: Witnessed:

______________________ ______________________

8/10/69

CONSULTANT AGREEMENT

THIS AGREEMENT made as of the day of , 196 by and between THE BABCOCK & WILCOX COMPANY, a corporation existing under the laws of the State of New Jersey and having an office at 161 East 42nd Street, New York City, New York 10017 (hereinafter called "the Company") and HENRY O. CRIPPEN, of New York City, New York (hereinafter called "The Consultant").

WHEREAS the Company wishes to engage the Consultant's services as specified herein, and the Consultant is ready, willing and able to undertake the rendition of such services:

NOW, THEREFORE, the parties agree as follows:

1. Description of Services - The Consultant shall furnish advice, consultation and related services pertaining to the Company's test program relative to the Consultant's pipe bending concept and patent application, which is the subject matter of a certain Option Agreement between the Company and the Consultant, dated . The Company agrees to utilize the Consultant's services as consultant for not less than one hundred (100) days during each annual period that this Agreement remains in effect.

2. Compensation - For time actually spent rendering services, the

Company shall pay the Consultant one hundred dollars ($100) per calendar day of eight hours or more (and pro rata for fractional parts of a day when less than eight hours) for the first one hundred (100) days of such services during each annual period that this Agreement is in effect, and seventy-five dollars ($75) per calendar day in excess of one hundred. The Company shall pay actual reasonable costs of travel, meals and lodging necessarily incurred by the Consultant in rendering services hereunder, but not any other fees, costs or expenses. The Consultant shall submit a statement for each month in which services are rendered showing the fee and other charges payable with respect to services rendered during such month. In accordance with its accounting procedures, the Company shall remit to the Consultant the appropriate amount.

3. Inventions, Discoveries or Improvements - The Consultant shall report in writing the details of every invention, discovery or improvement (whether patentable or not) made or conceived by the Consultant alone or in conjunction with others relating to subjects or matters referred to in Section 1 hereof, or relating to, arising out of, or emanating from services rendered hereunder. The Consultant shall assist the Company and its nominee in obtaining patents covering said inventions, discoveries or

improvements in any and all countries, and shall execute or have executed all papers needed in applying for and obtaining any such patents, and shall sign and deliver instruments of assignments of such patents to the Company, all as requested by the Company. All such inventions, discoveries and improvements (whether patented or not) shall be and shall remain the property of the Company.

4. Security and non-Disclosure of Information - The Consultant shall be responsible for, and bear the expense of, compliance with governmental laws and regulations applicable to the procurement, utilization or production of information in connection with the furnishing of services hereunder. The Consultant shall keep secret and confidential such information pertaining to the Company, its activities, products, organization or internal affairs as the Consultant may acquire during the term of the Agreement. The Consultant shall not, during such term, aid any individual or organization in competition with the Company regarding matters or subjects similar or related to those either referred to in Section 1 hereof, or dealt with in furnishing services hereunder.

5. Drawings, Designs and Data - All drawings, designs, specifications, notebooks, tracings, photographs, negatives, reports,

findings, recommendations, data and memoranda of every description, and all copies thereof, furnished to the Consultant or developed in the course of or relating to the services rendered hereunder shall be the property of the Company and the Consultant shall not retain copies of any such matter or material.

6. Term - This Agreement shall automatically terminate on the date on which the earliest of the following events occurs relative to the option the Consultant has granted to the Company pursuant to the Option Agreement referred to in Section 1 hereof:

(i) the Company exercises its option, or

(ii) the Company notifies the Consultant in writing that it will not exercise its option, or

(iii) the option expires.

IN WITNESS WHEREOF, this Agreement has been executed as of the day and year first above written.

THE BABCOCK & WILCOX COMPANY

____

____

HENRY O. CRIPPEN, CONSULTANT

PDX-6

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

POST OFFICE BOX 217
MORRISANIA STATION
NEW YORK, N. Y. 10456

August 27, 1971

Dear Mr.

It was good to talk to you the other day and bring you up to date on our progress in establishing the Crippen Pipe Fabrication Corporation. As you suggested, I am writing this letter to briefly describe the assistance we need now from so that we may in turn serve you.

One of the conditions of our investors is that prior to release of any funds, we obtain advance sales commitments amounting to at least one million dollars, which is about 50% of our initial break-even sales level. These advance sales commitments are to be in the general form of the enclosed Confirmation of Intent obtained from but with a starting date of March 31, 1972. In view of your considerable requirements for power piping, I would hope that would be willing to make a commitment for a share of the advance sales that we require.

A copy of our Confidential Report describing our overall business plan, manufacturing facilities and organization is enclosed. At your convenience, we would welcome the opportunity to meet with you and other members of your organization to provide you with more detailed information on our planned operations.

You can appreciate that for us to move ahead and fulfill our commitments for a March 1972 start-up date, we must move rapidly to satisfy the requirements of our investors. Your willingness to assist us in this endeavor is greatly appreciated. If you have any questions, please do not hesitate to telephone me at (212) 889-0880 or at my home telephone (212) 991-1940.

Yours truly,

Henry O. Crippen

Henry O. Crippen

HC:n Encls.

PDX-7

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

POST OFFICE BOX 217
MORRISANIA STATION
NEW YORK, N. Y. 10456

May 25, 1971

Dear Mr.

As one of the first steps to satisfy you that the Crippen Pipe Fabrication Corporation has the capability to produce the quality of work that you require, we are enclosing a booklet which describes the Production, Quality Assurance, and Materials Handling Equipment which we plan to install in our manufacturing plant in the Brooklyn Navy Yard.

We would appreciate a review of this booklet by your Quality Assurance people. After they have had an opportunity to study this material, we would be pleased to meet with them so that we can answer any questions they may have.

A principal source of funds for our plant and equipment expenditures will be the federal Economic Development Administration (EDA). As part of our loan application, EDA requires us to obtain an independent opinion that our planned plant equipment and plant layout are adequate to produce the quality of product required by our customers. After your Quality Assurance people have completed the above review, we trust that you will be able to supply us with a letter stating that our planned plant equipment and plant layout is satisfactory to you.

Mr. Crippen and I are most grateful to you and your company for your assistance in getting our new venture successfully started.

Very truly yours,

Bruce Wallace
General Manager

BW:n
Encls.

PDX-8

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

POST OFFICE BOX 217
MORRISANIA STATION
NEW YORK, N. Y. 10456

January 13, 1971

Dear

Thank you for having the report on the Crippen Pipe Fabricat[illegible] Corporation reviewed by investment personnel despite the [illegible]ct that they have advised that our operation does not fit within your current investment objectives.

With extensive requirements for process piping, we hope that the Crippen Pipe Fabrication Corporation can be of service to you. With the well-equipped manufacturing facility that we are setting up at the Brooklyn Navy Yard and the crew of skilled personnel that we have assembled, we will be capable of handling your requirements for chromium and nickel steel alloy fabrication as well as carbon steel fabrication.

At this [illegible]int we need advance sales commitments from companies like [illegible]o have the technical expertise to judge our performance capability. With comprehensive specifications reinforced by the vario[illegible]s industry piping codes, and appropriate contingent requirements such as [illegible]ME certification and schedule commitments, we believe that the interests of could be well protected in such an advance sales commitment. The industry practice of awarding unit price contracts based on various discounts from the Pipe Fabricating Institute's standard price list provides the framework for the commercial terms.

We would welcome the opportunity to meet with purchasing and technical personnel so as to acquaint them with our capability. Your assistance in introducing us to the appropriate individuals would be most appreciated. I will telephone you in the coming week to see if such a meeting or meetings can be arranged.

Thank you very much for your assistance.

Very truly yours,

[illegible]

Bruce Wallace
General Manager

BW:r

Building 269, Brooklyn Navy Yard
Brooklyn, New York 11205
Telephone 212-858-2900

CRIPPEN PIPE FABRICATION CORPORATION

PDX-9

Dear

As I indicated in our telephone conversation, I am enclosing three copies of our introductory brochure prepared to acquaint clients, and prospective clients, with our location, facilities, and equipment.

Please feel free to distribute these brochures as you desire and do not hesitate to request additional copies of these, or to ask for any other information you require.

Thank you for your assistance and for the opportunity you are affording Crippen Pipe Fabrication Corporation regarding the pipe fabrication you require.

I hope to be talking with you within the next few weeks at your office if at all possible.

Yours truly,

H.O. Crippen

Henry O. Crippen, MCS
President

27 November 1972

HOC:ah
Encl.

PIPE BENDING AND FABRICATION

PDX-10

...its Money on Bending Technique

By LORRIE YARCZENSKI

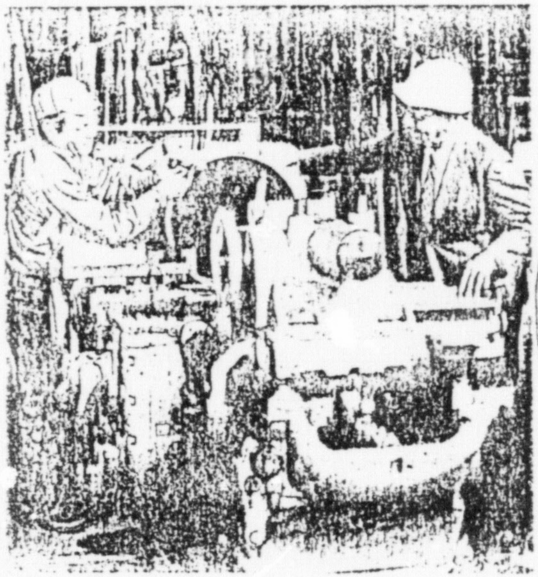
NEW YORK — Still in the process of settling into headquarters at once-deserted Brooklyn Navy Yard, the head of the first black-owned pipe fabricating company [illegible] unlimited opportunities for expansion.

Henry O. Crippen, president of the Crippen Pipe Fabrication Corp., believes that a special pipe bending and fabrication process he invented, which recently has been granted a patent, will enable his company to meet and even top competitors.

"Our biggest advantage, of course, is this unique hot pipe apparatus," Crippen explained in an interview. "We also have some of the most highly skilled journeymen in the industry. There are no schools that can teach pipe bending; our people have been students of experience."

Geometric Principles

According to Crippen, his process "eliminates the guesswork" in pipe bending by setting guidelines for employes in the machine. Geometric principles, such as tangents and arcs, are built directly into the apparatus so the operator will not have to rely on his own judgment.



CRIPPEN TALKS with lathe operator in firm's facility in former Navy Yard.

The process eliminates the welds and stretching that are often a result of pipe bending, Crippen said.

"Our area of expertise is in bending heavy wall pipes at a cost that is economical," Crippen stated. "In the market, we lean toward the power industry, for which most other shops are not able to fabricate in all alloys and in the large diameters that this industry demands."

A 30-year veteran in the pipe industry, Crippen began his career in hot pipe bending at the Sunship & Drydock Co., Chester, Pa., in 1942. In the early '50s, he set up shop with 13 men for a New York firm and built it up into 200 employes. It is now one of his major competitors.

Wanted His Own Shop

After 25 years of research and experimentation in pipe bending, Crippen received his United States patent in 1969, adding to foreign patents he had been awarded in Italy, France, Belgium and Canada. Although he received "an overwhelming response from industry" on his patented process, Crippen said, he wanted to open his own shop, but failed to muster either trained management or financial backing.

Two years ago, he sought assistance from the Interracial Council for Business Opportunity, a nonprofit private organization here, which gave him office space, introduced him to partner Bruce Wallace, and raised $1.3-million in capital.

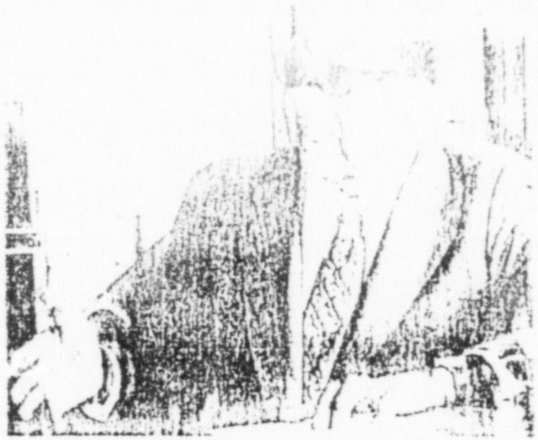
On Oct. 31, 1972, the Crippen Pipe Fabrication Corp. officially opened with the signing of a lease with the Commerce Labor Industry Corp. of Kings, the Navy's Yard's primary leasor.

Crippen credits the ICBO, together with Wallace and other top staff members — Norman Stewart, who controls sales and production, and Charles Seymour, financial vice-president — for helping to develop a "real team effort" that has made the venture possible.

Other Equipment

In addition to its patented pipe bending apparatus, the company has stick electrode, [illegible] arc, tungsten and metal arc welding equipment; induction and car-type, full-furnace stress relieving equipment; pipe cutting, burning and blasting equipment; cleaning and painting equipment, and various radiography and ultrasonic quality assurance devices.

Expecting to be in full production by the spring, the firm is already filling orders for Du Pont and Allegheny Power Co., and has received commitments from Combustion Engineering, Foster Wheeler Corp., Riley Stoker Corp., Consolidated Edison, General Electric and Mobil Oil, among others.



HENRY O. CRIPPEN: Sees company's competitive position hinging on recently patented pipe bending and fabrication process he developed.

At present, the company has 14 employes, with plans to increase this number to 32 by the end of the year. Goals have been set to increase sales from $1-million the first year to $4-million for 1974, to as high as $7-million by the end of 1975.

Crippen, who estimates that about 75 percent of his labor force will be black, said he will hire most of his employes from nearby impoverished neighborhoods.

'72 Union Electric Net Tops Year Ago

PITTSBURGH — Union Electric Steel Corp. reported earnings of $3,120,000, or $2 a share, for 1972, compared with earnings of $2,531,000 or $1.66 a share in 1971.

Net sales in 1972 were $23,035,000, compared with $18,070,000 for 1971.

Lewis A. Wible, [illegible]dent, stated that current order backlogs continue to remain [illegible]

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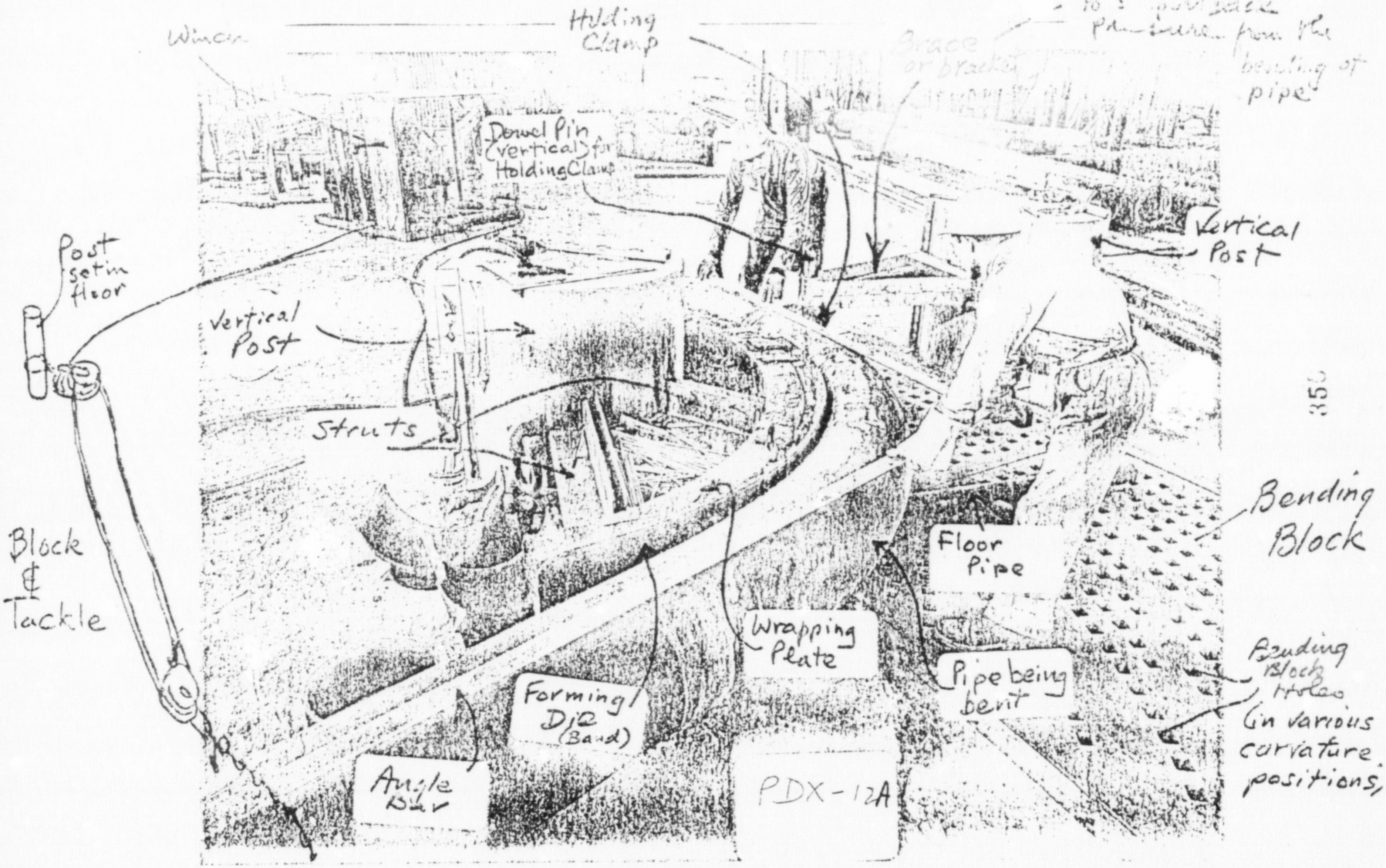


Winch
Holding Clamp
from the bending of pipe
Brace or bracket
Dowel Pin (vertical) for Holding Clamp
Vertical Post
Post set in floor
Vertical Post
Struts
Bending Block
Floor Pipe
Block & Tackle
Wrapping Plate
Pipe being bent
Bending Block Holes (in various curvature positions)
Forming Die (Band)
Angle Bar
PDX-12A

PDX-18

June 3, 1971

Mr. Henry Crippen
601 E. 167th Street
Bronx, N. Y.

Re: Your Patent #3,456,468

Dear Henry:

With respect to your above-referenced patent, we find that no essential element claimed by you to be novel is in fact novel, and that most elements have either been used by Tubeco for many years prior to March 23 of 1967 or were tried and discarded prior to that time.

Tubeco does not consider your patent valid, and it will continue to use all of the procedures which it presently is using and has used in the past.

Very truly yours,

TUBECO, INC.

ABW:ck

Allen B. Wesler
President

cc: Bertram S. [illegible], Esq.
Dannenberg, Hazen & Lake

PDX-28

7-2-73
SS

Control No. 1

CRIPPEN PIPE FABRICATION CORPORATION

CONFIDENTIAL REPORT

November 1970

This report is for the confidential use only of persons to whom it is transmitted.

CRIPPEN PIPE FABRICATION CORPORATION

I. DESCRIPTION OF THE COMPANY

1. Industrial Pipe Fabrication

The Crippen Pipe Fabrication Corporation is an industrial enterprise incorporated under the laws of the State of New York to be primarily engaged in heavy, industrial pipe bending and fabrication. The principal products of this company will be fabricated carbon steel and alloy pipe assemblies, as required in the construction of modern steam power plants, chemical plants and oil refineries.

Heavy industrial pipe fabrication is performed by a relatively few companies throughout the United States. The Pipe Fabricating Institute, the trade association which sets the technical and commercial standards for the industry, has a membership of about fourteen companies.(1)

2. Mr. Henry D. Crippen

Mr. Crippen, President of the Crippen Pipe Fabrication Corporation, has considerable experience and knowledge in the industrial pipe bending and fabrication business. He was in charge of pipe bending for the Sun Shipbuilding Corporation in Eddystone, Pennsylvania for a number of years. More recently, he was employed by Tubeco, Inc. (formerly Carl Pipe Bending and Fabricating Corporation) in Brooklyn, New York.

The hot pipe bending equipment at Tubeco's present plant was designed by Mr. Crippen and represents his early efforts to devise an improved pipe bending apparatus. Knowledgeable experts in the pipe fabricating industry have stated that the Tubeco equipment designed by Mr. Crippen was the best in the industry.

CRIPPEN PIPE FABRICATION CORPORATION

With Mr. Crippen as principal owner, the Crippen Pipe Fabrication Corporation will be the first black-owned company in the industrial pipe fabrication industry.

3. Patented Pipe Bending Apparatus

On July 22, 1969, the United States Patent Office issued[1] patent number 3,456,468 to Henry O. Crippen for a "Hot Pipe Bending Apparatus and Method." Major cost savings can be achieved through the use of this invention because of the reduction in labor, shop time, rework and intermediate girth welds.

Mr. Crippen's patented apparatus represents a significant improvement over any equipment or method currently in use in the industry. All of the components or concepts embodied in this apparatus have been tested and proven on full-size equipment. Since filing the basic patent in 1967, Mr. Crippen has developed additional devices which provide further production cost savings.

[1] See Appendix

CRIPPEN PIPE FABRICATION CORPORATION

III. MANUFACTURING PLAN

1. Facilities

The manufacturing facility required for the company's operations is a heavy duty, single floor, high ceiling, industrial building containing approximately 30,000 square feet. Office space amounting to 2500 square feet is required adjacent to the manufacturing area. An overhead 15-ton travelling cab crane with a 35 foot minimum lift is required to service the manufacturing area. As most of the raw materials and products are shipped by rail, a rail siding up to, and preferably into, the building is required. Access to water transportation is desirable but not essential. Electric power for a demand load of 400 KVA at normal industrial voltages and a natural gas supply for a demand capacity of 20,000 SCFH is required. Compressed air and heating steam will be obtained as a utility or generated on-site.

2. Equipment

The principal equipment required for the plant is as follows:

a. Lifting Equipment

1.) 15-ton Overhead Crane, 38'- Lift

2.) 5-ton Overhead Crane, 35'- Lift

3.) 5-ton Overhead Crane, 42'- Lift

4.) 3-ton Revolving Jib Crane, 30' dia. span

5.) 9 Jib Cranes mounted on building columns

b. Welding Equipment

1.) Semi-automatic, Submerged Arc Welding Equipment

2.) Micro wire CO_2 Welding Equipment

3.) Metal Inert Gas (MIG) Welding Equipment

4.) Tungsten Inert Gas (TIG) Welding Equipment

CRIPPEN PIPE FABRICATION CORPORATION

5.) Manual Metal Arc Equipment

6.) Gas Welding Equipment

7.) Brazing Equipment

8.) 2 Pipe Rotators and Positioners, 40-ton capacity

c. Stress Relieving Equipment

1.) 180 KVA Fully Programmed and Recording Induction Preheating and Stress Relieving Unit

2.) Gas Fired Stress Relieving Furnace with Automatic Recording.

d. Hot Pipe Bending Equipment

1.) Patented Apparatus enabling compound pieces to be bend-formed with precision accuracy and producing full area, wrinkle-free bends in piping up to 30" diameter

2.) Heating Furnace thermostatically controlled, front loader enabling up to 3 pipes to be heated at one time

3.) Sand Filling and Packing : Three Tier Packing Rack 32' high, providing for as many as 8 pipes to be erected for sand filling at one time

4.) Sand Storage Pit 17'- X 8'-6" X 6' - deep

5.) Insulated Area for slow cooling of alloy materials

e. Cold Pipe Bending Equipment

Pipe Bending Machine to bend coils, tubing and pipe, capacity up to 6" diameter, pipe walls to schedule 80

f. Machining and Weld Preparation Equipment

1.) 2 Facing, Beveling, Boring and Grooving Machines, capacity to 30" O.D.

2.) Automatic, Semi-Automatic, and Oxy-Acetylene Burning Equipment

CRIPPEN PIPE FABRICATION CORPORATION

3.) Band Saw

4.) Abrasive Cut-Off Machine

5.) Contour Nozzle Shaping Machine

6.) Air Arcair Cutting Machine 600 AMP

7.) Bench Type and Portable Drill Presses

8.) Bench Type and Portable Grinders

g. Cleaning and Painting Equipment

1.) Sandblasting and Shot-Blasting Equipment

2.) Turbinizing Equipment for cleaning inside of pipe

3.) Paint Spraying Equipment

3. <u>Manufacturing Schedule</u>

The basic manufacturing schedule calls for a [redacted] period for facilities set-up and testing, a second [redacted] period of initial production during which a [redacted] annual sales rate is attained, a [redacted] period of "full" production during which a [redacted] sales rate is attained, followed by a [redacted] production expansion period in which the production is increased to a [redacted] annual sales rate. This growth rate for sales and related employment is believed to be conservative, but it provides a sound basis for financial planning.

Activities involved in the set-up and testing period include reconditioning of a leased plant, purchase and installation of equipment, fabrication of certain special equipment, hiring of lead personnel, testing of equipment, production of sample assemblies, qualification of welding procedures, development of sales materials, and establishment of minimum inventories.

CRIPPEN PIPE FABRICATION CORPORATION

At the outset o. the initial production period ASME code certification will be obtained, additional personnel will be hired and trained, normal job procedures will be established and a major sales development program undertaken. After about one year of full production special ASME nuclear systems certification will be obtained.

CRIPPEN PIPE FABRICATION CORPORATION

V. ORGANIZATION

1. Functional Responsibilities of Management Personnel

President

Production Management
Union Relations
Personnel Management
Community Relations

General Manager

Marketing Management
Financial Management
Coordination of Sales, Engineering, Purchasing and Production Activities
Contract Services - Legal, Financial, Etc.

Sales Manager

Customer Relations
Sales Planning
Proposals
Advertising

Chief Engineer

Plant Maintenance
Estimating and Cost Control
Materials, Services, and Equipment Requisitioning
Production Scheduling
Inspection and Quality Control
Code and Client Certification

Purchasing Manager

Materials, Services and Equipment Purchasing
Traffic Management
Office Management
Inventory Control
Financial Records
Personnel Records

Shop Foreman

Production Control
Training

CRIPPEN PIPE FABRICATION CORPORATION

2. <u>Organization Chart</u> - End of First Year

President

General Manager

Sales Manager	Chief Engineer	Shop Foreman	Purchasing Mgr
Sales Engineer	Maint. Engineer	Welder (3)	Secretary-Bookkeeper
	Project Engineer	Pipe Fitter (3)	Shipping Clerk
Secretary	Draftsman	Pipe Bender (2)	
		Machinist (2)	
		Helper-Apprentice (4)	
		2nd Class Helper (3)	
		3rd Class Helper (2)	

CRIPPEN PIPE FABRICATION CORPORATION

PROJECTED INCOME STATEMENTS

FIRST FIVE YEARS OF OPERATION

CRIPPEN PIPE FABRICATION CORPORATION

PROJECTED BALANCE SHEETS

FIRST FIVE YEARS OF OPERATION

Item	Year

CRIPPEN PIPE FABRICATION CORPORATION

CASH FLOW PROJECTION

FIRST FIVE YEARS OF OPERATION

Item	Year

CRIPPEN PIPE FABRICATION CORPORATION

CASH FLOW PROJECTION

FIRST YEAR OF OPERATION

Item Month

CRIPPEN PIPE FABRICATION CORPORATION

Notes on the Income Statements, Balance Sheets and Cash Flow

CRIPPEN PIPE FABRICATION CORPORATION

BREAK - EVEN SALES LEVELS

FIRST FIVE YEARS OF OPERATION

Item Annual Rates at the end of the year

VII. FINANCIAL STRUCTURE

1. Capital Requirements

CRIPPEN PIPE FABRICATION CORPORATION

PIPE FABRICATION INSTITUTE PUBLICATIONS

STANDARDS

ES1—End Preparation and Machined Backing Rings for Butt Welds (August 1965) $1.00

ES2—Method of Dimensioning Welded Assemblies (August 1964) $1.00

ES3—Fabricating Tolerances — Minimum Bending Radii — Minimum Tangents (November 1965) $1.00

ES4—Shop Hydrostatic Testing of Fabricated Piping (1959) $1.00

ES5—Cleaning Fabricated Piping (September 1962) $1.00

ES7—Minimum Length and Spacing for Welded Nozzles (September 1962) $1.00

ES8—Preheat and Postheat Welding Practices for Low Chromium-Molybdenum Steel Pipe (March 1964) $1.00

ES9—Shielded Metal-Arc Welding Dissimilar Ferritic Steels (May 1964) $1.00

ES10—Stress Relieving Welded Attachments (April 1964) $1.00

ES11—Permanent Identification of Piping Materials (September 1962) $1.00

ES12—Preheat and Postheat Welding Practices for Medium Chromium-Molybdenum Steel Pipe March 1964) $1.00

ES13—Classification of Shop Testing, Inspection and Cleaning (August 1964) $1.00

ES14—Magnetic Particle Inspection (April 1964) $1.00

ES15—Recommended Radiographic Interpretation of Tungsten Inert Gas Welds (April 1962) $1.00

ES16—Access Holes and Plugs for Radiographic Inspection of Pipe Welds (April 1962) $1.00

ES17—Liquid Penetrant Inspection (April 1962) $1.00

ES18—Ultrasonic Inspection of Seamless Piping (October 1962) $1.00

ES19—Heat Treatment of Ferrous Pipe Welds (September 1964) $1.00

ES20—Wall Thickness Measurement of Pipe Bends by Ultrasonic Resonance Inspection (September 1964) $1.00

ES21—End Preparation for Manual Inert-Gas Tungsten-Arc Root-Pass Welding (August 1965) $1.00

TECHNICAL BULLETINS

TB1—1960 Pressure-Temperature Ratings of Plain End Pipe Used in Power Plant Piping Systems $2.00

TB2—1956 Pressure Ratings for 90° Unreinforced Branch Connections of Seamless Steel Pipe $1.00

TB3—1963 Guide Lines Clarifying Relationships and Design Engineering Responsibilities Between Purchasers' Engineers and Pipe Fabricator or Pipe Fabricator Erector (June 1963)

PIPE FABRICATION INSTITUTE MEMBERSHIP

Cornell & Underhill, Inc
Hoboken, New Jersey

Grinnell Company, Inc.
Providence, Rhode Island

Fabricating Division
Chas. F. Guyon, Inc.
Harrison, New Jersey

The M. W. Kellogg Company
Power Piping Division
Williamsport, Pennsylvania

National Valve and Manufacturing Co.
Pittsburgh, Pennsylvania

Nelson Company
Holmes, Pennsylvania

Piping Engineering Company
Tulsa, Oklahoma

Pittsburgh Piping and Equipment Co.
Pittsburgh, Pennsylvania

Power Piping Company
Pittsburgh, Pennsylvania

Benjamin F. Shaw Company
Wilmington, Delaware

Stearns-Roger Corporation
Denver, Colorado

Taylor Engineering Corporation
Detroit, Michigan

Tubeco Inc.
Brooklyn, New York, N. Y.

Western Piping & Engineering Co. Inc.
San Francisco, California

7-2-73

PRODUCTION, QUALITY ASSURANCE AND MATERIALS HANDLING EQUIPMENT

This booklet describes the Production, Quality Assurance and Materials Handling Equipment which the Crippen Pipe Fabrication Corporation plans to install in their manufacturing plant in the Brooklyn Navy Yard.

May 15, 1971

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

PRODUCTION, QUALITY ASSURANCE AND MATERIALS HANDLING EQUIPMENT

TABLE OF CONTENTS

May 15, 1971

TABLE OF CONTENTS

(Continued)

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

HOT PIPE BENDING APPARATUS

Number of Units - One

Equipment as described in United States Patent 3,456,463

comprising:

a) Bending Block 24' x 24'

b) Forming Dies

c) Holding Shoes

d) Adjustable Shoes

e) Position Clamps

f) Base Template Protractors

g) Check Set

h) Bending Winch

i) Stanchions

j) Block and Tackle

k) Miscellaneous Accessories

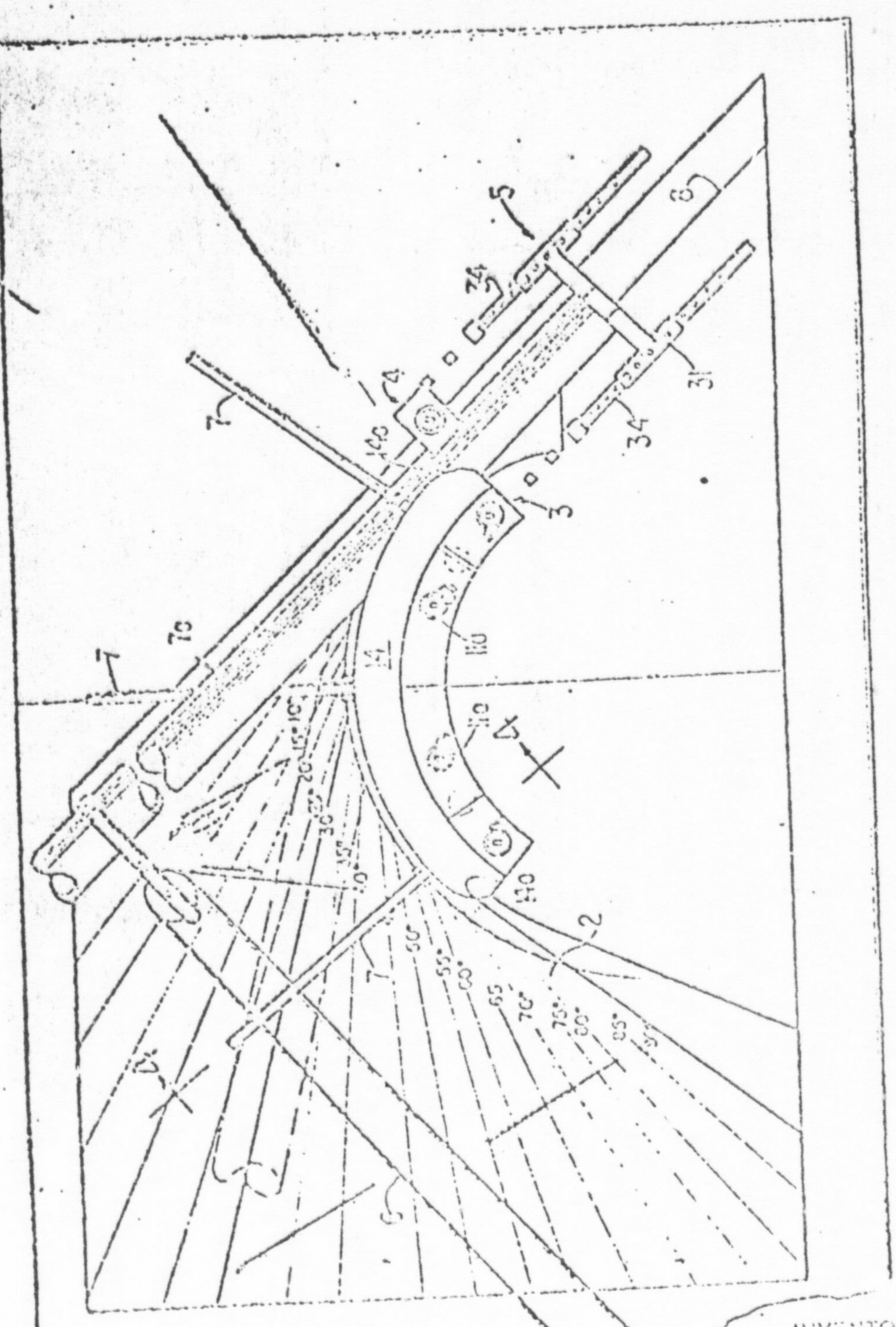
July 22, 19[illegible] H. O. CRIPPEN

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 22, 1937

5 Sheets-Sheet 1

FIG. 1



INVENTOR
HENRY O. CRIPPEN
BY
[illegible]
ATTORNEYS

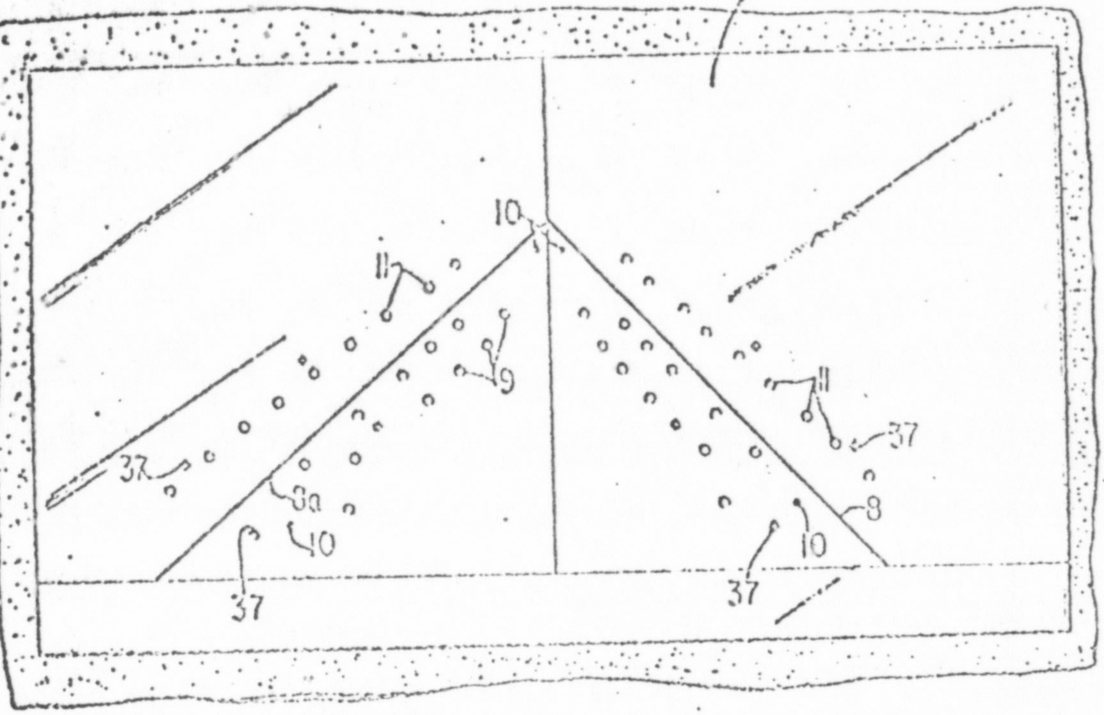
380

July 22, 1969 H. O. CRIPPEN 3,456,488

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet 2

FIG. 2



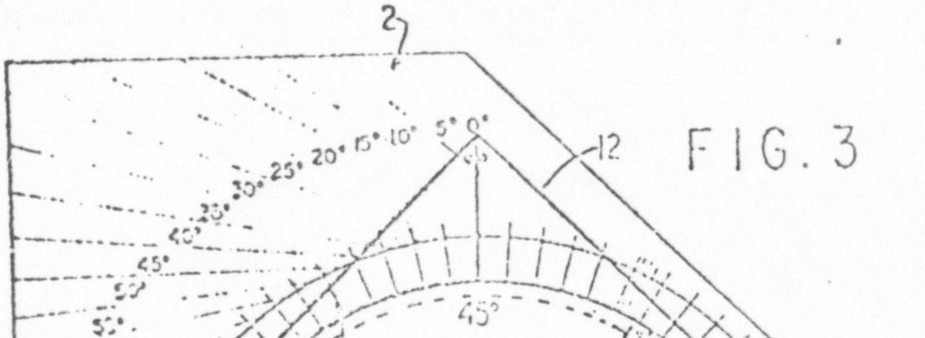


FIG. 3

INVENTOR
HENRY O CRIPPEN
BY
ATTORNEYS

July 22, 1969 H. O. CRIPPEN 3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 23, 1967 5 Sheets-Sheet 3

FIG. 5

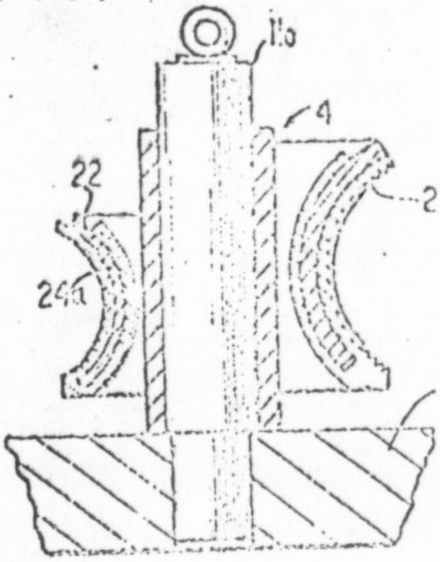


FIG. 6

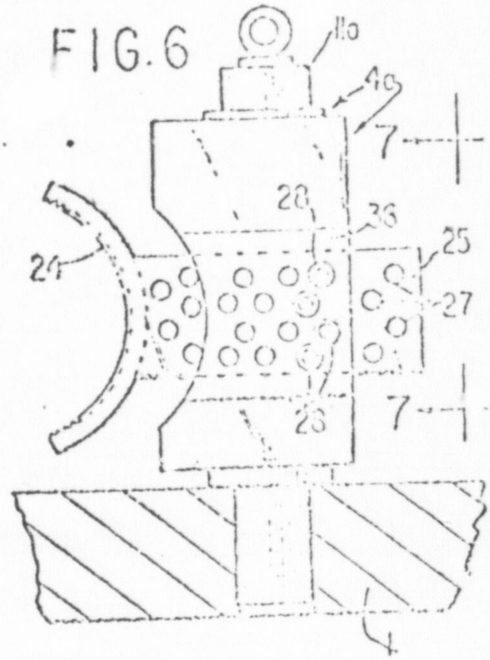
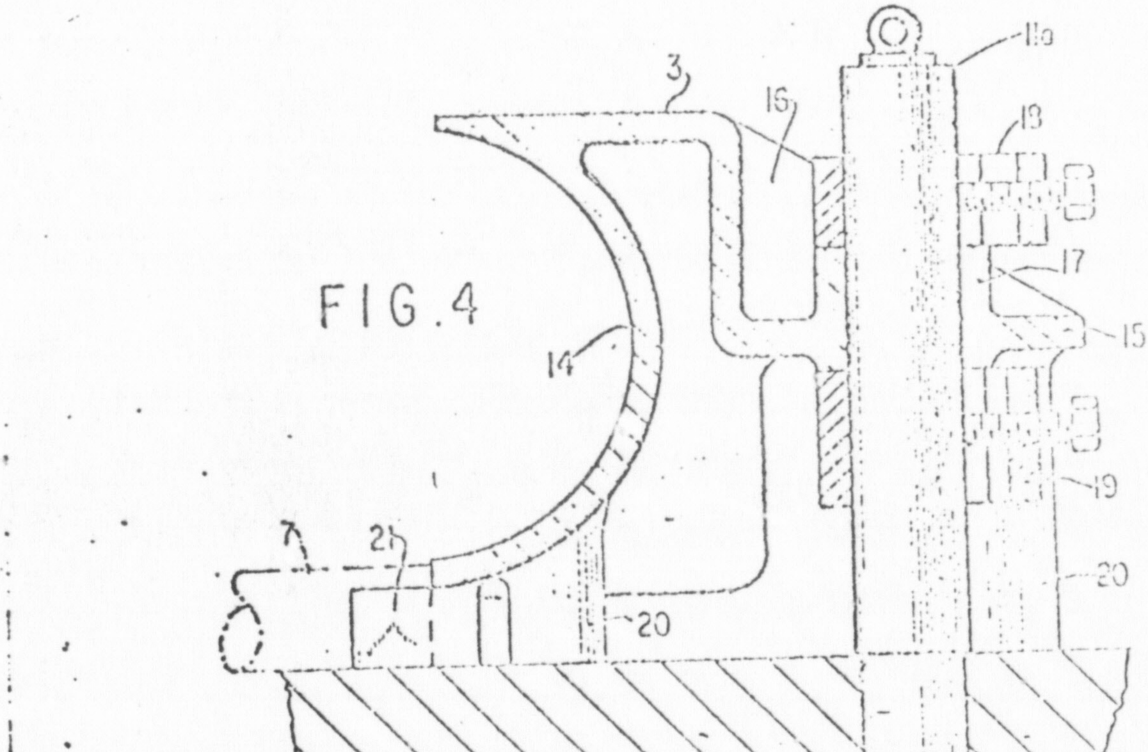


FIG. 4



INVENTOR
HENRY O. CRIPPEN

BY

ATTORNEYS

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet 4

FIG. 7

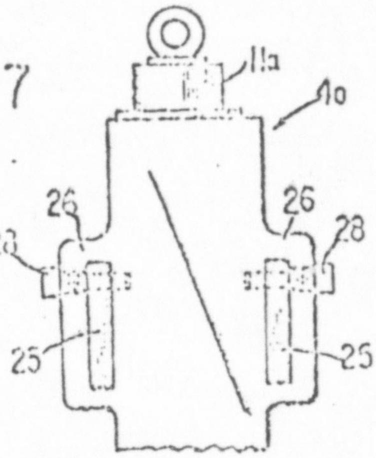


FIG. 8

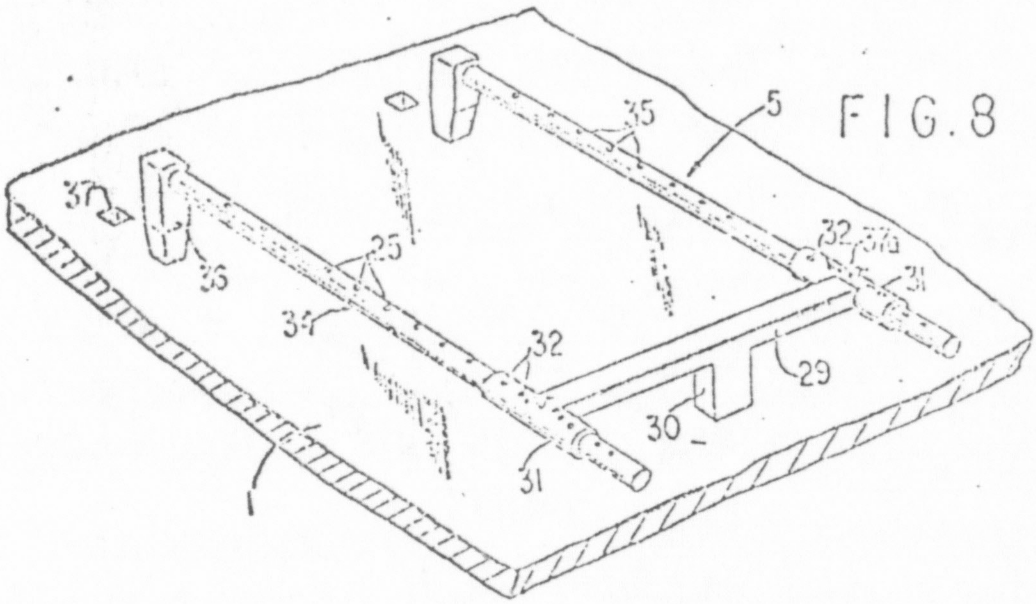
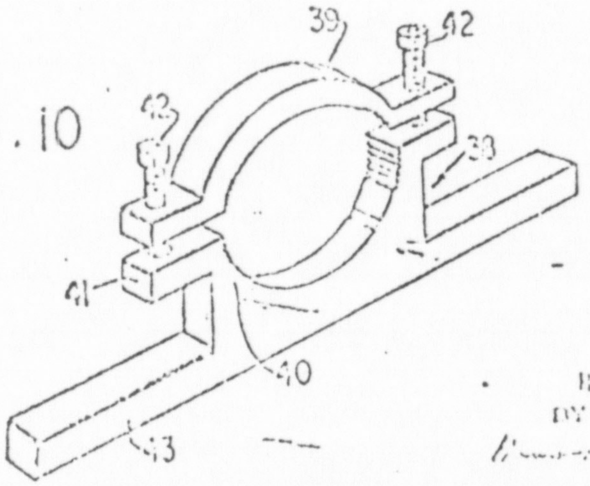


FIG. 10



INVENTOR
HENRY O. CRIPPEN
BY
ATTORNEYS

July 22, 1969 H. O. CRIPPEN 3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 23, 1967 5 Sheets-Sheet 5

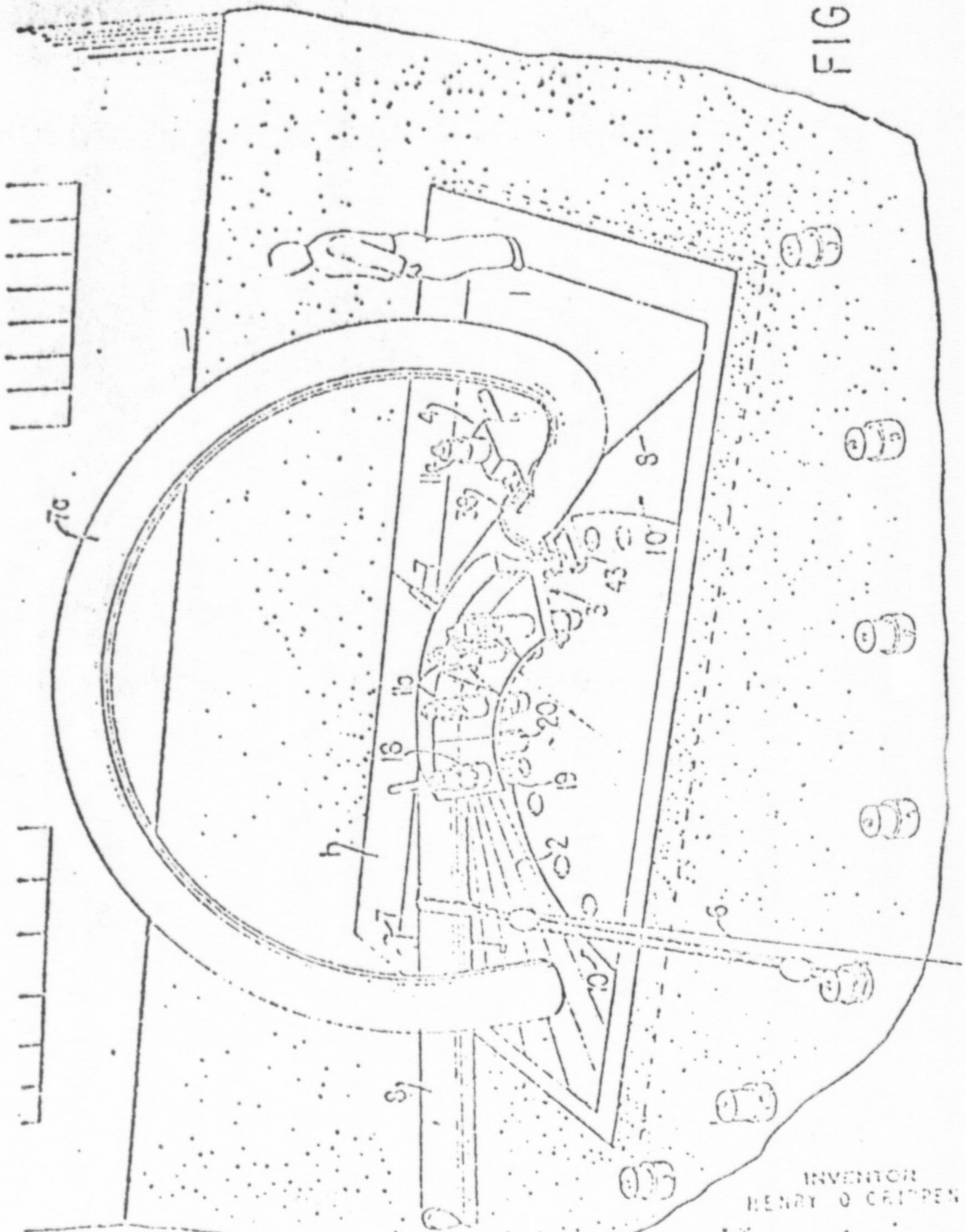


FIG.9

INVENTOR
HENRY O CRIPPEN
BY
ATTORNEYS

1

3,456,469

HOT PIPE BENDING APPARATUS AND METHOD

Henry O. Crippen, 601 E. 167th St., Bronx, N.Y. 10456

Filed Mar. 23, 1967, Ser. No. 625,458
Int. Cl. B21d 9/05
U.S. Cl. 72—34 12 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for heat-bending large diameter pipe comprised of a bending block provided with guidelines forming a 90° angle, base template protractor, arced forming dies with about 180° grooved curvature face and having varying radii, means for holding one end of the pipe against the forming die during bending, means for maintaining the pipe level within the curvature face and means for applying pressure to bend the hot pipe about the die and a method of bending a hot pipe rapidly with a minimum of secondary operations and butt welding.

Prior art

Large diameter pipes are used in construction of many plants and buildings and for many installations they must be bent in specific ways in order to fit into the design conditions. Present methods of bending large diameter pipe have been costly due to the number of skilled men and the time required in the bending operation, the inaccuracy of the present system which results in waste of pipe or requires subsequent treatment by skilled personnel, and the difficulty in obtaining compound bends in a pipe. In the most common pipe-bending operations being used today, the pipe, which is filled with sand, is heated to a high temperature, i.e., 1500 to 2000° F., in a furnace and then set up on the bending table, which has a variety of holes therein. The starting end of the pipe is securely fastened and the portion of the pipe to be bent is without control of the angle of the bend and this portion rides free, resting on the bending table. The angle of the bend is controlled by the skill of the bender, by the use of a template, water and movement of the holding attachments and the angle of pulling leverage. The bending pressure is applied by a capstan with the use of several pulleys and a rope. The pulleys are held by stanchions. The rope is passed around the pulleys and connected to the pipe to be bent and the rope is then wrapped several times around the capstan. The bending pressure is started by tightening the rope around the revolving capstan and the bending pressure is relieved by releasing the rope. This operation is repeated until the desired angle of bend in the pipe is attained. During the operation of the bending, two men hold a template (usually a heavy wire bent to the desired angle of the bend) over the pipe to make certain the correct angle and radius of bend is obtained.

In addition to the men holding the template, a capstan operator and a man with a water hose are required. Water spraying of the hot pipe has two primary purposes: (1) to affect the radius of the pipe when the bend is closing in too sharply by spraying water on the outer side of the pipe to chill this portion of the pipe and stop or slow the bending in that portion, and (2) to prevent buckles in the pipe caused by the throat being too hot by spraying the inner side of the pipe with water. This operation requires not only four men and a great deal of time, but also a high degree of skill and experience. In addition, only clockwise or counterclockwise bends may be made on existing apparatus.

The said procedure has many disadvantages. One disadvantage resides in the amount of time required to perform the bend, since the pipe cools rapidly and more

2

pressure is required to bend the pipe the more it cools. For example, the tensile strength of one common pipe metal at 1600° F. is 10,000 pounds per square inch, while at a temperature of 1250° F., the same metal has a tensile strength of 35,000 pounds per square inch, an increase of 3.5 times in tensile strength over a temperature drop of only 350° F. Under normal plant conditions, metal pipes will cool approximately 100° F. per minute and, therefore, the tensile strength of pipes and the pressure necessary to bend the pipes increases rapidly. If the pipe becomes too cold during the bending operation, too much pressure is required and flattening of the pipe walls occurs. Moreover, sharp or abrupt pulls on the pipe during bending thereof will cause thinning in the pipe walls which weakens the pipe. Faults caused by overbending, underbending, buckling, flattening or the like cause a high amount of rejects which increases the cost of pipe bending operations.

For proper bending, the outer side or heel of the pipe should be hotter, since the heel has to stretch and the inner side or throat of the bend only has to compress. When water is used to cool the inner side of the pipe, it will frequently cool one section of the throat of the pipe too much, which section becomes harder than the surrounding pipe sections and causes buckle. Thinning will occur due to uneven stretching and/or compression. If the throat of the pipe is unevenly cooled, the hotter portions of the throat will compress faster and cause buckles. If the far end of the pipe remains hotter than the portion of the pipe being controlled by the water, the pipe will bend farther ahead of the portion to be bent instead of following gradually the desired radius and the bend will not have the proper arc or radius.

Objects of the invention

It is an object of the invention to provide a novel apparatus for accurately and rapidly bending large diameter pipe with small crews.

It is another object of the invention to provide a novel apparatus for bending large diameter pipe without the use of water for cooling.

It is a further object of the invention to provide a novel pipe bending apparatus which may be used for different size pipes to obtain bends up to 360° with varying radii and to obtain accurate compound bends in pipe.

It is another object of the invention to provide a pipe bending apparatus in which large diameter pipes may be bent clockwise or counterclockwise.

These and other objects and advantages of the invention will become obvious from the following detailed description.

The apparatus of the invention for bending large diameter pipes is comprised of a bending block provided with two guide lines forming a 90° angle and preferably provided with a plurality of holes therein; a base template protractor resting on the bending block marked off in degrees from 0 to 90° with the 0° line coinciding with one of the guide lines on the bending block and the 90° line coinciding with the other guide line on the bending block, an arced forming die, preferably having slightly more than a 90° arc, with a 180° grooved curvature face and have a radius substantially equal to the radius of the desired pipe bend, the said die being securely centered on the bending block so that the bottom lip of the forming die curvature at each end at [illegible] of this curvature face meets a guide line on the base template protractor at tangential points of the base template protractor, means for holding one end of the pipe to be bent against the forming die [illegible] line on the base template protractor, means for bending

the pipe level during the bending operations, and pressure applying means to bend the pipe about the die the desired number of degrees.

The [illegible] ing block is a rectangular steel block which is preferably made in [illegible] pieces for handling ease during construction thereof. The said block acts as a table upon which the hot pipe is bent and is set in the floor of the bending plant and is preferably level with the plant floor. On each side of the bending block at specified distances therefrom, holes are provided in the floor of the bending plant which accommodates stanchions which can be raised or lowered to provide for the positioning of the pressure applying means at a height so that the pipe is bent in a plane parallel to the floor. The angle of the applied pressure may be varied and clockwise and counterclockwise bends may be made by the proper selection of the stanchion.

The bending block is provided with two guide lines thereon which form a true 90° angle and these two guide lines provide a reference point layout for the bending block holes and for all of the equipment that fits thereon. Preferably, the bending block has a plurality of holes arranged along the two guide lines whereby forming dies may be secured with dowel pins passing down through dow[illegible] in sleeves provided on the form plate of the forming [illegible] and engaging the holes in the bending block. The dowel pins in the holes secure each forming die in the proper relationship to the guide lines on the base template protractor. In a pref[illegible] embodiment, the bending block has 38 of the [illegible] holes positioned with respect to the angle formed [illegible] guide lines to accept various sized forming dies for bending pipes of 6" to 18" diameter and the holding shoes. [illegible] bending of larger diameter pipes, i.e., up to 24" diameter, additional holes may be provided.

The holes in the bending block are arranged so that the center of the hot pipe, when it is in the forming die at the start of the bending operation, lies along one of the two guide lines. The forming die must be held securely in position on the bending block so that there is no movement thereof during the bending operation. The dowel pins and holes in the bending block provide the simplest method of securing the forming die without complicated attachments. For ease of handling, the dowel pins holding the forming die may be provided with eyehooks so that they may be removed from the holes in a simple fashion.

The base template protractor is secured on the bending block and fits around the base of the forming die. The said protractor is provided with degree lines from 0° to 90° at right angles to the radius of the forming die so that constant observation of the degree of the bend may be made during the entire bending process. The 0° line coincides with one guide line on the bending block upon which the hot pipe is laid at the start of the bending operation and the 90° line coincides with the other guide line. A second scale is preferably provided on the base plate protractor along the base of the curvature face of the forming die and coinciding with the center line of the pipe being bent and extends slightly beyond the outside diameter guide line. The 0° mark indicates the start of the bend in the pipe and the scale indicates the circular degree of the bend so that the exact position of the end of a bend can be marked on the pipe and a second bending operation may be effected, if necessary. The degree of the bend are [illegible] the tangential point where the unbent portion of the pipe meets the forming die.

The base template protractor may also be provided with a [illegible] guide line [illegible] which [illegible] the [illegible] of the hot pipe in the forming die. This [illegible] diameter of [illegible]

faces, one face used for clockwise bending and the [illegible] face used for counterclockwise bending, depending [illegible] its position on the bending block. A base template protractor is provided for each die to be used and each base template protractor coincides exactly with the two guide lines on the bending block whether it is used for clockwise or counterclockwise bending.

To secure the base template protractor in position, the bending block and the said protractor may be provided with cooperating holes so that dowel pins can pass through the template into the bending block. The said protractor provides a means for constantly observing the degree of the pipe bend from the start of the bend to the finished angle.

The forming die is an important feature of the invention since it provides a form about which the hot pipes can be bent without buckles or wrinkles or flattening or thinning of the pipe walls. The forming die is comprised of a die body having a grooved curvature face with a peripheral arc of 180° and a diameter slightly larger than the diameter of the pipe to be bent, a form plate centered along the entire back of the die body provided with sleeves to accommodate dowel pins which pass therethrough and engage holes in the bending block. Gussets between the back of the die body and the form plate may be provided for further strengthening of the die body. When the forming die is in position on the bending block, the bottom lip of the curvature face fits concentrically with the second scale of the base template protractor. Preferably, the ends of the top lip of the curvature face are elliptically shaped so that the hot pipe to be bent may be easily inserted into the forming die along the guide line and clamped into [illegible] rigidly.

The length of the die curvature for bending 18" diameter pipe is approximately 185 degrees in circumference. The dies for bending up through 15 inch diameter pipes may be varied from 180 degrees up to [illegible] degrees in circumference. The center of the forming die, when it is in position, should coincide with the middle of the 90° angle formed by the two guide lines on the bending block.

The curvature face of the forming die should be slightly elevated from the bending block so that the hot pipe in the bending position is slightly elevated to allow the pressure applying means to be attached to the hot pipe while keeping the hot pipe in a level plane. The curvature face and the form plate may, therefore, be provided with pedestals for their support. To support the hot pipe during the bending operations, a plurality of riding pipes or other means of the same height as the inside bottom lip of the curvature face are provided to keep the neutral axis of the pipe parallel to the neutral axis of the forming die. The riding pipes may be [illegible] in recesses under the bottom lip of the curvature face and radiate from the curvature face.

The sleeves of the form plate of the die body are slightly larger in diameter than the dowel pins [illegible] the holes in the bending block. To take [illegible] between the said sleeves and the dowel [illegible] used. However, it is preferred to provide the [illegible] the top and bottom thereof with [illegible] can be hand tightened [illegible] the dowel [illegible] movement of the die when bending pressure [illegible] the pipe.

Means are necessary to hold one end of the [illegible] to be bent against the [illegible] the back pressure [illegible] about the forming die [illegible] One [illegible] is [illegible]

normally be in position to hold 12" diameter pipe. To hold different size pipes, the height of the neutral axis of the curvature face can be raised by spacer rings under the holding shoe so that the axis of the curvature face will lie in the same plane as the neutral axes of the forming die and the pipe. By this means, one curvature face can be used to hold pipes having 6" to 12" diameters and the other curvature face can be used to hold pipes having 12" to 18" diameters.

The holding shoe may be held in position by a dowel pin passing through the body of the holding shoe and engaging a hole in the bending block. This arrangement allows the holding shoe to be pivoted about the dowel pin so that the curvature face may be turned aside to allow more room for insertion or removal of the pipe from the forming dies. The holding shoe is positioned so that the pipe of a specific diameter is securely held in the forming die for that diameter. If odd size pipe is to be bent, i.e., a 9" diameter pipe in a 10" diameter forming die, the curvature face of the holding shoe may be provided with a correspondingly shaped shim insert to compensate for this difference in diameter.

While the said holding shoe is completely adequate for bends up to 90° in a pipe, difficulties arise with this shoe when bends of more than 90° are being made since the bent portion of the pipe to be held after the initial bend does not lie along the 0° guide line of the primary scale of the base template protractor but is concentrically aligned with the extended outside diameter guide line on the base template protractor. For this type of bending another holding shoe having a laterally adjustable curvature face is used.

This latter modification of holding shoe is provided with an adjustable extension arm on each side of the holding shoe which supports the curvature face whereby the curvature face can be moved laterally towards the pipe so that the pipe is held in conformity with the extended outside diameter guide line on the base template protractor. The neutral axis of the curvature face is offset from the middle of the holding shoe body so that the curvature face will be in position for holding 6" diameter pipe and when the holding shoe is inverted the curvature face will be in position for holding 12" diameter pipe. The said holding shoe may be raised with spacer rings for holding larger size pipes as with the previously described holding shoe.

The extension arms are preferably provided with 36 holes and the holding shoe is preferably provided with 12 holes on each side. The said holes are arranged so that 4 holes on each extension arm will coincide with 4 holes on each side of the holding shoe in varying positions so that 4 pins may be inserted through each side of the extension arm and the holding shoe to firmly hold the curvature face in the final position.

In a preferred embodiment of the apparatus, an adjustable stop means is provided for proper positioning of pipes when they are placed in the forming die for bending up to 90°. This stop means may be an adjustable stand rack with a stop-bar which acts as a backstop called a chock set. The stop-bar of the chock set may be slidably moveable along two channel tubes to provide for a plurality of bend tangents and is capable of being securely affixed thereto in any desired position. The forward ends of the channel tubes may be attached to square pegs which fit into square holes in the bending block to hold the chock set in position. The position of the stop-bar is preadjusted to stop the end of the pipe to be bent at the computed tangent dimensions so that the heated pipe will be aligned in the proper position for the start of the bend when inserted in the apparatus with its end abutting against the stop-bar.

In order to hold the pipe properly in position [illegible] making compound bends or second bends in circular bends, a position clamp is provided to prevent [illegible] of the pipe during the [illegible] bending process [illegible] to hold the pipe during the second bend of circular bends since the chock set is not used for these bends. This clamp may be made of two semi-circular parts which form a circular collar. Both circular parts are preferably provided with jagged teeth to clamp onto the pipe when the two parts are fastened together. The bottom semi-circular collar is provided with a base to prevent turning of both the pipe and clamp during the bending process. After the initial bend is put in the pipe, which is to have a compound bend put therein, the pipe is then put in the desired position in the forming die for the next portion of the bend. The position clamp is then placed about the pipe and firmly clamped thereto. The pipe may then be heated with the position clamp attached and re-inserted into the forming die so that the pipe can be rapidly aligned and no time for adjustment of the pipe is lost once the pipe is heated for the second portion of the compound bend. The height of the base of the position clamp should be such that the bottom semi-circular collar lies in the same plane as the inner bottom lip of the curvature face of the forming die so that the neutral axis of the pipe will be in the same plane as the neutral axis of the forming die curvature face.

The pipe bending apparatus of the invention has a wide variety of advantages, the most important of which are accurate rapid bending of pipes, whether simple, circular or compound bends or clockwise or counterclockwise or both, with a minimum of skill and number of men and equipment. The bending block provides a base for a large variety of setups for different bends. The base template protractor provides a simple means of constant observation of the angle of bend of the pipe.

The forming die due to its deep segmental curvature face provides a constant, protective support to the pipe along the entire portion of the pipe being bent thereby providing synchronization of the gradual stretching of the heel of the pipe and the compressing of the throat for proper following of the radius of the forming die. This prevents sharp abrupt pulls or bends and prevents thinning of the wall of the pipe. Since the pipe is never deviated from its bending course with the use of the forming die, the use of water on the pipe during bending is completely avoided and the disadvantages which occur with the use of water do not occur in the bending process. The forming die also extracts heat from the throat of the pipe and renders the inner side of the pipe cooler during the bending, which prevents the pipe from compressing too fast on its concave face. This coolness of the throat gives additional strength or stiffness, enabling it to resist creasing caused by the pressures put on it by the pull of the bend. This is advantageous since the heel or outer side of the pipe should be hotter during bending as it has a farther distance to travel and stretch while the throat has only to compress.

Another advantage of the apparatus of the invention is that bending may be done rapidly and little time is lost in positioning the pipe. This is important since pipes must be bent while hot and the longer the time between removal from the furnace and the completion of the bend, the more difficulties arise. The apparatus provides for an even bending pressure and the pipe follows the continued arc of the forming die which prevents the pipe from being bent sharply and prevents disruption of the compressing and stretching of the throat and heel of the bend. This lessens the chance of buckles that occur with the known methods of bending.

Referring now to the drawings:

FIG. 1 is a plan view of the pipe bending apparatus of the invention with the pipe in position for the start of the countnclockwise bend.

FIGS. 2 and 3 are plan views of the bending block and the base template protractor, respectively.

FIG. 4 is a cross-sectional view of the forming die of FIG. 1, taken along line 8—8.

FIG. 5 is a cross-sectional view of one holding shoe used to hold the pipe in position during bending.

FIG. 6 is a side view of an adjustable holding shoe used to hold the pipe in position when performing a bend of more than 90°.

FIG. 7 is a cross-sectional view of the holding shoe of FIG. 6, taken along line 7—7.

FIG. 8 is an enlarged view of the chock set of FIG. 1.

FIG. 9 is a view of another embodiment of the pipe bending apparatus of the invention during compound bending of a large diameter pipe.

FIG. 10 is an enlarged view of the position clamp of FIG. 1.

In the embodiment illustrated in FIG. 1, the pipe bending apparatus, ready to begin a bend, is comprised of bending block 1 set in the floor of the pipe bending shop, and provided with guide lines 8 and 8a which form a true 90° angle, approximately along the center line of the bending block, a base template protractor 2, forming die 3 centered on the 90° angle, holding shoe 4, chock set 5, block and tackle 6 attached to a winch (not shown), and riding pipes 7 which keep the pipe 7a level with the inner bottom lip of the forming die.

As can be seen from FIG. 2, the bending block 1 is provided with a series of holes 9 along guide lines 8 and 8a within the angle formed thereby which engage dowel pins 11a to secure forming dies for different diameter pipes to the bending block. The bending block is also provided with smaller holes 10 which engage pins to secure base template protractor 2 thereto and with holes 11 along guide lines 8 and 8a outside the angle formed thereby to engage dowel pins to secure the holding shoe 4 in various positions for different diameter pipes.

In FIG. 3, the base template protractor is shown as provided with two sets of degree markings from 0° to 90°. On the primary set 12 of degree markings, the 0° line coincides with guide line 8 of the bending block and the 90° line coincides with guide line 8a when the base template protractor is secured to the bending block. The degree lines of this scale radiate tangentially from the forming die so that the degree of the bend in the pipe can be easily observed throughout the bending. In the secondary set 13 of degrees, the 0° mark coincides with the portion of the forming die 3 at which the bend will start and runs radially to 90° with the 45° mark coinciding with the center of the 90° angle formed by guide lines 8 and 8a. The secondary scale 13 permits a bender to determine the radial degree at which a bend has stopped when bending more than 90°. The pipe 7a may then be marked where the bend stopped, be re-heated and reinserted into the die with the mark on the pipe aligned with the 0° mark of the secondary scale for the start of a second bend.

The forming die 3 as shown in FIG. 4 is comprised of a curvature face 4 ensuring that the heated portion of the pipe will be protected, form plate 15 secured to the back of curvature face 14 and gussets 16 which provide strength to the forming die. Form plate 15 is provided with sleeves 17 through which dowel pins 11a pass and engage holes 9 in bending block 1. The top and bottom of sleeves 17 are provided with adjustable collars 18 and 19 which firmly clamp the die body in position. The curvature face 14 and form plate 15 are provided with pedestals 20 to support the forming die, and to elevate the curvature face slightly above the surface of the bending block so that the block and tackle 6 may be attached to pipe 7a during the bending [illegible] changing the place of the bend. The top of [illegible] pipes 7 coincides with the inner bottom lip of curvature face 14 and is held in position by brackets 21. As [illegible] in FIG. 1, the outer edges 14a of the upper lip of curvature face 14 are [illegible] so that [illegible] pipe [illegible] directly on guide line 8 [illegible] the forming die curvature face.

FIG. 5 [illegible] holding shoe 4 [illegible]

provided with two curvature faces 22 and 23 which are provided with jagged teeth to firmly grip the pipe. The arc of the said curvature faces is approximately 90°. Curvature face 22 is positioned so that the bottom lip thereof is elevated above the bending block slightly higher than the riding pipes 7 so that it may be used to hold small diameter pipes, i.e. 6" to 12", while the curvature face 23 is more elevated above the bending block to hold larger diameter pipes, i.e., 12" to 18". The neutral axis of the forming die curvature face to be used is precisely in the same plane as the neutral axes of the pipe to be bent and the curvature face of the holding shoe. To accommodate odd size pipes, i.e., 9" diameter, the curvature faces of the holding shoe may be provided with a shim 24a to take up the difference.

Holding shoe 4a of FIGS. 6 and 7 is especially useful for compound bending and in putting a second bend in a circular bend since the curvature face 24 can be moved laterally to engage the bent portion of the pipe which will not lie along guide line 8. The curvature face 24 is held on either side by extension arms 25 which slide in slots 26 of the holding shoe.

The extension arms 25 are provided with 4 rows of 9 holes, 27, while the body portion of the holding shoe is provided with 4 rows of 3 holes in each, which are arranged so that 4 holes in extension arms 25 will correspond with 4 holes in the body of the holding shoe, so that the distance between curvature face 24 and the holding shoe body can be varied in 1" increments. The extension arms are held firmly in position by pins 28 which pass through the 4 aligned holes in the extension arms and the holding shoe body.

The chock set, shown in detail in FIG. 8, is used so that the portion of the pipe where the bend is to start will be aligned with the 0° mark on the secondary scale of the base template protractor when the end of the pipe 7a is abutting against the chock set 5. The chock set is comprised of a stop-bar 29 provided with a pedestal 30 in the center thereof and with tubular collar sleeves 31 at either end thereof, which sleeves have a plurality of holes 32 drilled therethrough. Passing through each of collar sleeves 31 is an extension channel tube 34 provided with a plurality of holes 35 drilled therethrough and with a square pin at the end thereof to hold the channel tubes parallel to the bending block at the same height as the stop-bar 29. The square pins 36 engage square holes 37 in the bending block in order to hold the chock set in position. The stop-bar 29 can be moved along the length of channel tubes 34 to the desired position and secured therein by passing pins 37a through the holes in the collar sleeves and in the channel tubes.

To bend a pipe, a forming die with a curvature face of the desired radius and diameter and its base template protractor are secured to the bending block with dowel pins 11a. Holding shoe 4 is positioned on bending block 1 with its curvature face turned aside from the forming die 3. To bend a pipe up to 90° with the apparatus of the invention, the length of the arc of the bend is marked off on the pipe 7a where the bend is to begin and to end. The die 3 and base template protractor 2 for this bend radius and diameter of pipe is positioned on the bending block 1 with the inner side of the base template protractor adjoining the bottom lip of the curvature face of the forming die and the holding shoe 4 is positioned in the proper hole in the bending block for the diameter of the pipe 7a. The chock set 5 is [illegible] that the butt of the pipe 7a [illegible] bar 29 [illegible] the beginning of the bend [illegible] with the 0° mark on the secondary scale 13 of the base template protractor 2. The pipe 7a [illegible] to the [illegible] bending apparatus [illegible] The pipe [illegible] line 8 with its butt [illegible] the stop-bar 29 of [illegible] 5 and [illegible]

pressure is applied. The block and tackle 6 is attached to the end of the pipe 7a and the winch is operated to bend the pipe about the curvature face of the forming die and the desired number of degrees.

Although FIG. 1 illustrates the bend as starting from the right side of the bending block, the holding shoe 4 and chock set 5 may be located at the left side of the bending block and the bend can be made from the left side to the right side of the bending block.

FIG. 9 illustrates the apparatus of the invention putting the third bend in a compound bend in a pipe 7a. The chock set is not used since the end of the pipe does not end along guide line 8. The portion of the pipe 7a where the bend is to begin is marked on the pipe and position clamp 38 is attached to the pipe to prevent the pipe from twisting or turning during bending.

As can be seen from FIG. 10, position clamp 38 is comprised of an upper semi-circular collar 39 and a lower semi-circular collar 40 provided with lugs 41 having threaded holes so that the two halves of the clamp can be securely held together by bolts 42. The inner surfaces of the semi-circular collars are preferably jagged to ensure firm gripping of the pipe. Bottom semi-circular collar 40 is provided with a base 43 extending out on either side thereof which prevents twisting of the position clamp and pipe during bending.

Various modifications of the apparatus and method of the invention may be made without departing from the spirit or scope thereof and it is to be understood that the invention is to be limited only as defined in the appended claims.

I claim:

1. An apparatus for hot bending large pipes of at least 6" diameter comprised of a bending block provided with two guide lines forming a 90° angle; base template protractors to rest on the bending block provided with a primary scale marked off in degrees from 0 to 90° with the 0° line coinciding with one of the guide lines on the bending block and the 90° line coinciding with the other guide line on the bending block and a secondary scale with a scale from 0° to 90°, arced forming dies having approximately 180° grooved curvature faces and a radius equal to the radius of the desired pipe bend, the said die being securely centered on the bending block within the 90° angle formed by the primary scale and with the bottom lip of the forming die curvature face coinciding with the secondary scale of the base template protractor, means for holding one end of the pipe to be bent against the forming die when laid along either guide line on the base template protractor, means for keeping the pipe level with the curvature face of the forming die and pressure applying means to bend the hot pipe about the die the desired number of degrees.

2. The apparatus of claim 1 wherein the bending block is provided with a plurality of holes which cooperate with dowel pins to secure the base template protractor, the forming die and the holding means in position.

3. The apparatus of claim 1 having an adjustable stop means against which the hot pipe abuts during bending whereby the portion of the pipe where the bend starts coincides with the 0° mark on the secondary scale of the base template protractor with the pipe abutting against the said stop means.

4. The apparatus of claim 1 wherein the arc of the forming die is approximately 180°.

5. The apparatus of claim 1 wherein ends of the upper lip of the curvature face of the forming die are elliptically shaped whereby the pipe to be bent can be directly inserted between the holding means and the forming die.

6. The apparatus of claim 1 wherein the holding means is provided with at least one curvature face having an arc of approximately 90° and means for adjusting the height of the said curvature face so that the neutral axis of the curvature face will lie in the same plane as the neutral axis of different diameter pipe and forming dies.

7. The apparatus of claim 6 wherein the holding means is provided with two curvature faces on opposite sides thereof with one face being closer to the bending block than the other curvature face whereby the curvature faces will hold different diameter pipes.

8. The apparatus of claim 1 wherein the means for keeping the pipe level with the curvature face of the forming die are riding pipes radiating out from the die at a height level with the bottom lip of the forming die curvature face.

9. The apparatus of claim 1 for bending pipes more than 90° wherein the holding means is provided with a laterally adjustable curvature face having an arc of approximately 90° and means for adjusting the height of the said curvature face so that the neutral axis of the curvature face will lie in the same plane as the neutral axis of different diameter pipe and forming dies.

10. The apparatus of claim 1 provided with means for clamping the pipe whereby the pipe is held in position to prevent twisting and turning of the pipe during compound bending.

11. The method of bending large pipes of at least 6" diameter which comprises heating the pipe to the bending temperature, anchoring one end of the pipe and bending the pipe in a horizontal plane the desired number of degrees around the curvature faces of a continuous arced forming die which at the bending point extends approximately 180° around the pipe circumference and the radius of the arc is equal to the radius of the bend to be made and is spaced from the bending floor.

12. The method of claim 11 in which the pipe being bent rests upon riding supports which support the pipe spaced from the bending floor substantially the same distance the bending die is spaced from said floor.

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CHARLES W. LANHAM, Primary Examiner

LOWELL A. LARSON, Assistant Examiner

U.S. Cl. X.R.

72—342, 388

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

PIPE BENDING FURNACE

Number of Units: Two

Manufacturer: Automated Industrial Furnaces, Inc. or equal

Type: Gas fired

Maximum Continuous Operating Temperature: 2200° F.

Usable Inside Dimensions: Length - 12' - 9"

Height - 4' - 0"

Width - 4' - 0"

Heated Length Control: Sectionalized design consisting of six sections along the length of the furnace

Loading: From the front (long side)

Total Burner Capacity: 10,800,000 BTU/hr LHV

Number of Burners: 12

Type of Burners: Inspirating

Control: a) Bending Furnace - Two-point indicating controller with high temperature alarm

b) Stress Relieving and Bending Furnace - Six-point recording controller with high temperature alarm and cut-off

Crippen Pipe Fabrication Corporation

— INDUSTRIAL PIPE BENDING AND FABRICATION —

TIG WELDING EQUIPMENT

Number of Units: One

Manufacturer and Model: Westinghouse Model TWS, 300 Amp AC/DC Tungsten-Inert Gas Welder, or equal

Duty Cycle: 60%

Torch: Water cooled, 300 amp continuous duty rating

Accessories: 1) AC-DC High Frequency protected voltmeter and ammeter

2) Foot control

3) Running Gear with gas supply & water circulator

4) Smith H-1800A flowmeter-regulator, or equal

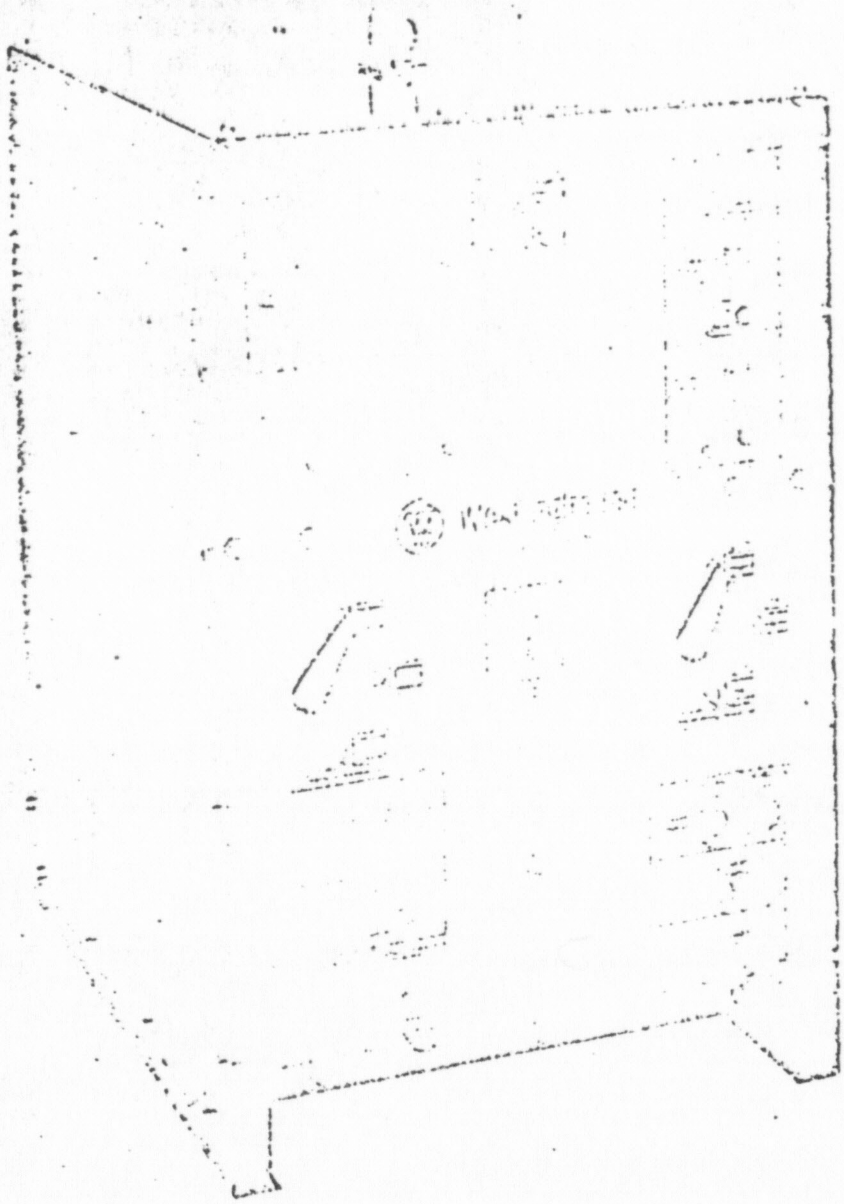
Westinghouse

ARC WELDING SUPPLY CO. INC.
467 BRUCKNER BOULEVARD
BRONX 55, N. Y. PHONE LU. 5-4200

Industrial AC/DC Welder Type TWS 300 Ampere

for Tungsten Inert Gas Welding

ITEM 5 (S



Type TWS

This versatile AC/DC welder, while specifically designed for the Inert Gas welding process, provides the user with the capability of performing most welding processes with one power source.

The type TWS is designed to operate from single phase AC power and will deliver AC welding power as well as straight or reverse polarity DC welding power to the arc.

Westinghouse has carefully designed, manufactured, and field tested this very versatile machine to assure long life and trouble-free service to the user.

The TWS is a static type power source, having no moving parts except for a motor driven ventilating fan. ... be sure of ... a ... of ... with ... maintenance and no down time.

Applications

With all controls readily available and clearly visible, the TWS may be easily adjusted for the welding of aluminum, magnesium, titanium, brass, copper, mild and stainless steels, alloy steels and other highly specialized alloy metals. Thin, medium or heavy plate, as well as thin gauge material, may be welded with ease.

The TWS AC/DC power source is a must for small job shops as well as for production line work.

Superior Features

New Static Control - The TWS welder is equipped with the all new Westinghouse static control which provides both thermal and control voltage compensation, virtually eliminating the periodic warm-up current adjustments which are necessary on most saturable reactor type AC/DC TIG power supplies and to minimize changes in output current caused by fluctuations in control voltage supply.

Hot-Soft Start Switch and Intensity Control Potentiometer permits the selection of starting current best suited to the type and thickness of material being welded.

High Frequency Start - Continuous - Off Selector Switch allows the operator a wide selection of welding processes from which to choose. The high frequency intensity is controllable by the operator by means of a stepless type rheostat mounted adjacent to the high frequency selector switch.

Overlapping, Wide Current Ranges ... excellent remote control ... the most exacting requirements as ... as ideal control of arc decay. Select from three ranges with a minimum of ... amperes to a maximum of 375 amperes ... rated load voltage.

Output Selector and Polarity Switch provides a fast, convenient means of adjusting to the type of welding power desired. AC or straight or reverse polarity DC available at the flick of the switch handle.

Water and Gas Flow Control a post flow adjustable timer provides up to ... seconds of gas flow after completion of the welding operation to shield the tungsten electrode and molten weld puddle from atmospheric contamination.

Remote Control Receptacle ... for remote control ... contactor and welding current ... remote selector switch ... operation ...

August 19..

Power Factor Correction This built-in feature minimizes power costs and improves overall plant power factor.

Overload Protection reduces output current to the minimum current on the range being used in event of an overload condition.

Surge Suppression assures maximum protection against transient voltage peak disturbances.

Westinghouse Silicon Diodes: A rectifier diode is the electrical equivalent of a check valve - it permits current to flow in one direction only. These silicon diodes provide an almost perfect check to reverse flow, and backleakage loss is practically negligible. Reduction in leakage not only reduces welder power consumption during idling, but helps improve the dynamic characteristics of the welder.
A diode, in contrast to its small size, has high current capacity. The active part of the cell is enclosed in a metallic case with a ceramic bushing: the whole enclosure is hermetically sealed. The diode is designed for easy mounting [illegible] to withstand rugged service con[illegible]ions.

Representing utmost reliability, these power diodes are Guaranteed for the lifetime of the welder.

Optional Equipment

Plug In-
Spot Welding Timer Control:
This control provides a means of varying the duration of welding current for spot welding applications. Accurate repetitive timing is assured by an auxiliary current relay. An auxiliary switch is provided for transition from welding to timed spot welding operation.

Plug In-
Remote Foot and Hand Controls:
Controls for remote operation of contactor only or both current and contactor are available. Remote current control can be limited to any preset maximum current by adjustment at the panel control. The new TWS foot control is a sturdy aluminum casting designed for many years of rugged service. Contact plugs supplied with remote controls mate to receptacles supplied as standard equipment on the TWS.

Pre-Purge Timer:
Permits a two second pre-flow of shielding gas and cooling water prior to initiation of the arc allowing hoses to be purged of unwanted weld contaminants.

Running Gear:
The TWS welder is basically to be used as a stationary power supply; however, if portability is desired, several models are available. Standard, semi-pneumatic tired running gear with towing handle and those equipped with bottle trays and water recirculating systems can be supplied.

Meter Panel: [illegible]
AC and DC voltmeters and ammeters are available for use with the TWS in a separate meter enclosure.

Optional Primary Ratings

The standard primary rating is 230/460 volts, single phase, 60 cycle. Alternate ratings are: 230/460/575 volts and 208/230/460 volts. For other voltages or frequencies, consult the Westinghouse Welding Department.

Associated Equipment

Electrodes - metallic arc welding of mild steel, alloy steels, stainless steels, and hard surfacing - PL 26-620 and TD 26-626.

Further Information

Prices: Price List 26-020

Electrical Ratings and Specifications (Subject to change without notice)

RATED AMPERES AT 32 LOAD VOLTS 60% DUTY CYCLE	OPEN CIRCUIT VOLTAGE	WELDING CURRENT RANGE AMPERES				PRIMARY AMPERES INPUT PER PHASE		ELECTRICAL PERFORMANCE (WITH POWER FACTOR CORRECTION)							DIMENSIONS AND WEIGHT			
								AT RATED LOAD					AT NO LOAD					
		min. at 20 load volts		average max. at 35 load volts		230 v	460 v	primary input kva		primary input kw		power factor percent	primary input kva	primary input kw				
		a-c	d-c	a-c	d-c			a-c	d-c*	a-c	d-c				H	W	D	Approx. Net Wt Lbs
300	80	5	5	375	375	90	45	20.7	22.1	16.5	19.2	75	6	0.55	41"	26"	32"	700

* correction applied for form factor

W[illegible] Electric Corporation
W[illegible], Industrial [illegible] Division, Sykesville, [illegible] 21784
[illegible]

MIG WELDING EQUIPMENT

Number of Units: One

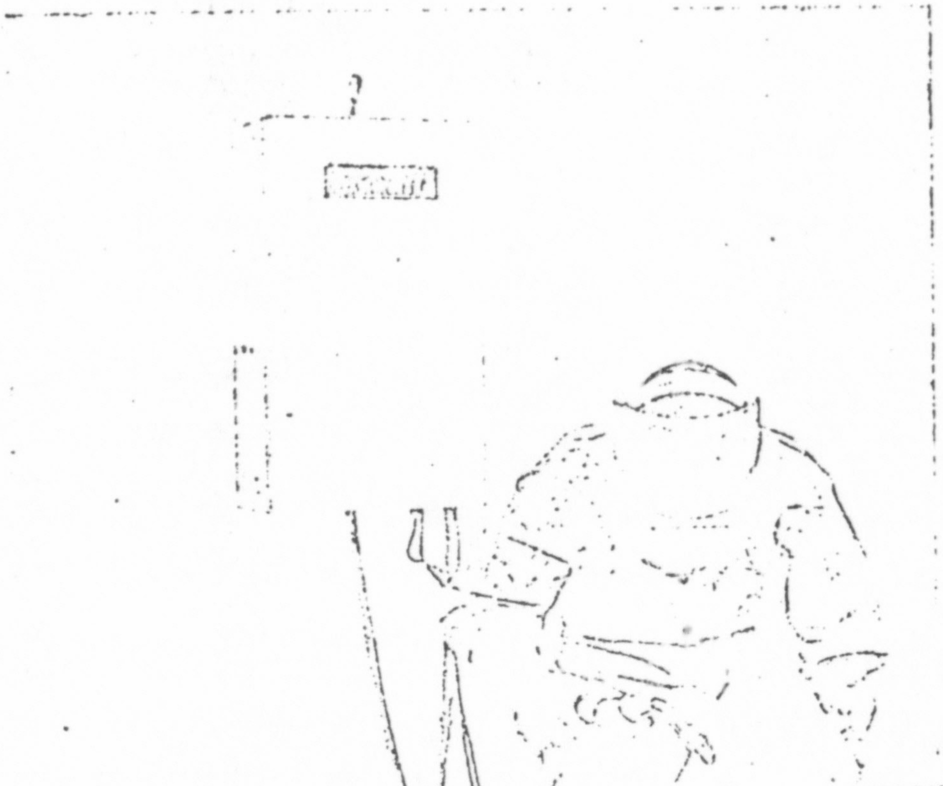
Manufacturer and Model: Westinghouse, or equal, Metal - Inert Gas Welding Equipment including;

1) Model RS 300 Amp Power Supply
2) Model SA 225 Control and Wire Feeder
3) Model HT-6 Torch
4) Smith Model H-1500A flowmeter-regulator

Westinghouse

Automatic Welding Systems

For Gas-Shielded, Consumable Electrode Welding



Purpose

The SA-200 S[illegible]ni-Automatic W[illegible] S[illegible]tems are designed to perform [illegible] now being done by [illegible]" thru [illegible]" [illegible] manual stick welding electrodes.

The economies of gas shielded [illegible] (MIG) welding with the slag [illegible] free performance make these [illegible] "must" for all types of fabricators [illegible] metal and for pipe welding. SA-[illegible] S[illegible]tems are extremely versatile [illegible] possible the realization of cost [illegible] MIG welding over stick welding.

Welds mad[illegible] with these system[illegible] for painting or plating—no chip[illegible] ing, or wire brushing is required. [illegible] cations to be used outdoors or in hu[illegible] environments, the weeping of [illegible] the weld toes—as is common [illegible] stick welding—is totally eliminated.

Gas shielded metallic arc weld[illegible] a [illegible] hydrogen" process. Hard-to-w[illegible] are easily joined using this [illegible] W[illegible] of X-ray quality are easily att[illegible] or argon, or mixtures thereof. [illegible] minum, magnesium, and gal[illegible] are now easily weldable—[illegible] stantial welding cost reductions.

Applications

Sheet Metal Fabrication: for[illegible] to-paint weldments from [illegible]" m[illegible] lightest gages, the SA-20[illegible] Welding on galvanized st[illegible] bronze filler wire produces [illegible] sion resistance with no after treatment.
Pipe Welding: the elimination of [illegible] ing, chipping and grinding be[illegible] make the gas shielded metallic [illegible] ideally suited for the welding of [illegible] joints of X-ray quality on both [illegible] mild steel are possible. The [illegible] torch allows welding in all posi[illegible]
Automotive Industries: from the [illegible] of frame clips and the weld[illegible] the maneuverability of the SA-[illegible] is ideal. Clean, spatter-free [illegible] minimum metal removal. The [illegible] poor fitup and the require[illegible] weld deposits are easily hand[illegible] the most inexperienced opera[illegible]
Railroad Car Manufacture: [illegible] and car sides are [illegible] with the SA-200 s[illegible] welds eliminate the [illegible] and paint bl[illegible]
Truck Body Fabrication: [illegible] obtained from the gas [illegible] process [illegible] electrode [illegible] values and [illegible]

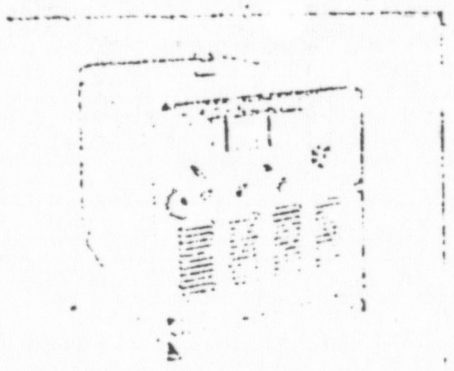
[illegible]

Westinghouse

Construction Industries: from window walls thru the requirements of hand rails, stairs and prefabricated beams, the SA-200 is ideally suited. The low cost, high strength weld deposits obtained are highly suited to this very competitive field.
Ornamental Iron: small, neat welds obtained from the MIG process eliminate the need for further metal working. Paint does not "weep" along the weld toes. Good sound weld deposits insure maximum strength to this field of metal working.
Metal Furniture: the use of gas shielded welding on chairs and tables increases productive output at a substantial decrease in cost. Plating or painting can be done on the finish weld with no further preparation. Clean, spatter free deposits lend good appearance to the finished product.
Rocketry: deposits of X-ray quality, good fatigue and high impact values are a requirement in this field. The SA-200 systems allow for accessibility into the many confined areas.
Shipbuilding: from deck house to superstructure, the SA-200 systems with their highly portable controls allow now for the economies of MIG welding where only stick welding was possible. Both for shop fabrication and shipway, this process is easily adapted.
Aluminum Fabrication: the use of gas shielded metallic arc instead of tungsten arc now allows welding 400% faster. Clean deposits, good gas shielding and high maneuverability of the welding torch makes the SA-200 system ideal for this metal fabrication.

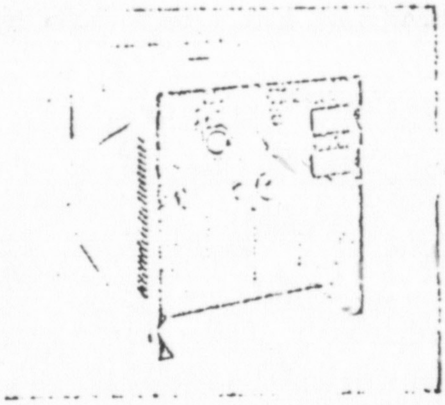
Power Supply

Type RS
The RS welder has been designed explicitly for small diameter wire welding. Built-in



[illegible] is the prime feature of this [illegible] welder. Elimination of "[illegible]" and "[illegible]" by a [illegible] and firm output slope gives the fabricator more trouble - free performance.
Available in both 200 and 300 ampere, 100% duty cycle ratings. Three phase input power for smoothest arc action.
115 volt AC auxiliary outlet located on the front panel. It supplies auxiliary power for operator's use anytime the "power" switch is "on".
A compact, high efficiency full wave silicon rectifier gives LIFETIME assurance of good performance.
Wide voltage range with ample overlap between ranges—to give a total available open circuit of from 14.5 thru 44 volts on the 200 amp unit and 21 thru 42 on the 300 amp unit.
Inverse time delay relay gives absolute protection from overloads.
Surge suppression across output of rectifier protects system from transient peak voltages.
Compact and stackable, the RS welder is designed for maximum production with minimum downtime.

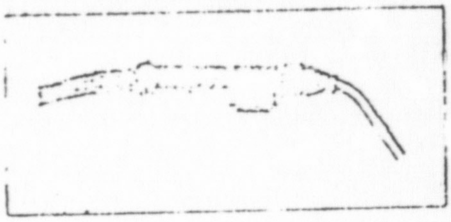
Type RCHS
For fabrication shops where only single phase power is available the type RCHS welder excels. Arc characteristics are controlled on this welder by means of a secondary inductor which limits the rate of change of welding current when used in the droplet transfer range.



Rated 200 amperes 60% duty cycle the RCHS welder has a voltage range of from 14 thru 35 open circuit volts.
Full wave rectification with high efficiency hermetically sealed silicon diodes guaranteed for the life of the equipment. (See Rectifier warranty page 4).
115 volt AC auxiliary outlet located on the front panel. It supplies auxiliary power for operator's use anytime the "power" switch is "on".
Built-in [illegible] in spray transfer [illegible] droplet type metal transfer.
Compact and stackable the RCHS welder is designed for maximum production with minimum downtime.
Clean sound welds can now be made in single phase locations with the inherent cost savings of MIG welding.

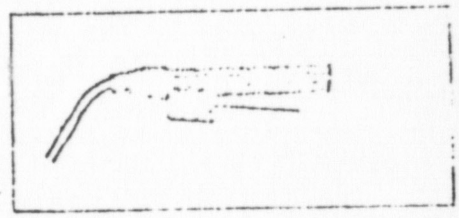
Torch

HT-6 and HT-6A
Lightweight and highly maneuverable for least operator fatigue.
Excellent gas coverage insures sound weld deposits and good arc action.



Internal liner in conduit on the HT-6 may be easily removed for cleaning. Allows friction free feed of wire. Poly-urethane lined conduit on HT-6A suggested for use on aluminum or stainless steel.
Conduit and hose assembly available in either 10 or 15 foot lengths. (HT-6A 10 ft. only).
Fully insulated throughout for maximum operator safety.
Model HT-6A available for 5000 series aluminum or magnesium.
Most important--gooseneck liner provides positive electrical pickup at contact tip.

HT-6C
Ideally suited for extremely heavy duty welding.



Lever trigger permits good operational control even with heavily gloved hand.
Slip in nozzle (or optional screw-on type) easily removable for cleaning.
Available with standard lengths of 10ft. cable and hose assembly. (3' and 15' lengths available on special order).
Heavy rubber boot protects cable and hose from sharp metal and [illegible].
Heavy duty [illegible] long service life and [illegible].
[illegible] for operator safety. Trigger [illegible] volts.

Automatic Welding Systems

For Gas Shielded Consumable Electrode Welding

Wire Feed System

SA-205

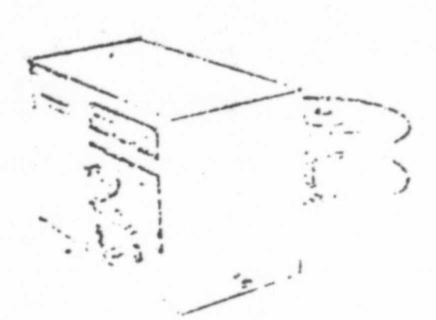
Standard unit equipped for wire speed up to 480 i.p.m. Gearing available for speed to 900 i.p.m.
Provisions supplied for swivel mounting on floor pedestal or welder top. Allows maximum reach of conduit.
Easy access to both circuitry and wire drive system thru hinged, quick latched doors.
Electronic circuitry permits motor to run at pre-selected speed with up to 400% overload on system.

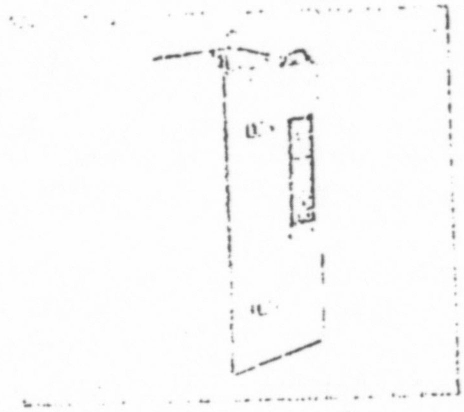
Double driven hardened wire drive rolls insure positive wire speed and no wire slippage. Entire drive mechanism enclosed for complete operator protection. Cabinet compartmentalized for maximum safety.
Line fuses in both sides of supply circuit to give utmost protection. Easily accessible from panel front.

SA-225

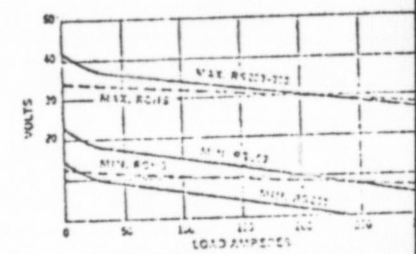
May be suspended from insulated hook shown or swivel mounted on top of welder. Pin and mounting plate supplied.

Wire speed maximum 480 i.p.m. see ta[…] below for currents achieved by wire s[…] and type.
Both wire drive system and spool are fu[…] insulated. Unit will accept either 25 or […] pound spools.
Both drive rolls are powered to give co[…] plete dependability in wire driving force.
Non-electronic circuitry gives comp[…] dependability and ease of maintenan[…]
Hinged doors allow easy access.
The SA-225A control is equipped with […] feature of gas pre-purge. A requirement […] aluminum, helpful for sound starts […] other metals.





Power Supply Volt-Ampere Characteristics



Specifications

Wire Size vs Current Range in Amperes

SA-225	Mild-Stainless Steel				Bronze		Deoxidized Copper		Alu[…]num 500[…] Ser[…]
Wire Speed Range	.030	.035	.040	.047	.035	.047	.035	.047	.04[…]
I.p.m. 120 - 480	40 thru 140	70 thru 210	100 thru*	150 thru*	60 thru 200	85 thru*	50 thru 210	110 thru*	75 […] 225

*Maximum current rating of system

	Power Supply			Control		Torch		
Model	RS-200	RS-300	RCHS-200	SA-205	SA-225	HT-6	HT-6A	HT-[…]
Shipping Weight	335 lbs.	370 lbs.	300 lbs.	70 lbs.	85 lbs.	10 lbs.	10 lbs.	12 l[…]
Size	†	†	†	18" x 20" x 13"	10" x 15" x 29"	10'	10'	10'
Primary Voltage	230/460	230/460	230/460	110 1-phase	110 1-phase	24 volt Trigger Circuit		
Primary Current	23/11.5	33/16.5	39/19.5	4	4			
Rating - Amperes	200	300	200			200	200	200
Duty Cycle	100%	100%	60%			100%	100%	10[…]
Power Factor	90	78	90					
KVA	8.8	13.3	9.0					
Efficiency	79	75	72					
Phase	3	3	1					

Notes:
Values given are for rated load at maximum voltage setting
Other voltages on request
Fifteen foot conduit and hose assembly available as optional extra
Eight foot and fifteen foot conduit and hose assembly available as an optional extra
Ampere rating [illegible] with argon-CO_2 [illegible] 200 ampere at 100% duty cycle
[illegible]
† All power supplies [illegible]

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

SUBMERGED ARC WELDING EQUIPMENT

Number of Units: Two

Manufacturer and Model: Lincoln Electric Company, or equal,

semi-automatic Submerged Arc Welding Equipment consisting

of:

1) Model SAF-600 Power Supply

2) Model K-117S Control Exciter

3) Model LN-5H Control and Wire Feeder complete with

voltmeter and ammeter

4) K-113 Submerged Arc Gun complete with K-11[illegible]

Cone

LINCOLN

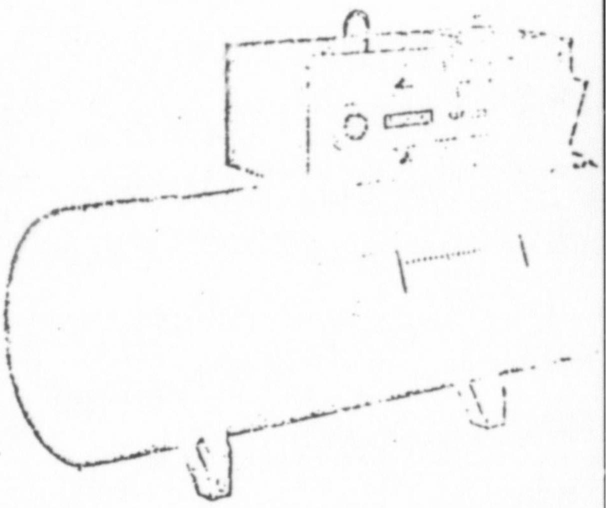
LINCOLNWELD® SAF-600

For Mechanized Welding.

Variable Voltage - Submerged Arc

Constant Voltage - "Innershield"® Open Arc

For Stick Electrode Welding



SPECIFICATIONS

Model SAF-600

Types*: 60 cycle, with field relay K-1215-F
60 cycle, with output contactor K-1215-0
60 cycle, with field reversing relay and output contactor K-1215-0F

Output Rating
Current (amps):
80% duty cycle 600
60% duty cycle 675
Arc Voltage (volts) 55

Current Range (amps) 80-750

Voltage Range (volts, OCV) 18-57

Output Characteristic .... Constant Voltage or Variable Voltage
(see curve, back page)

Auxiliary Power Available ... 1 KW of 125-volt DC, or 9 amps of 35-volt DC, plus 1150 VA of 115-volt AC

Available Optional Features .... 115-volt pushbutton circuits; Input Current Reducing Starter (See "Features"); Meters, Arc Gouging Protection; Type K-721 undercarriage

Suitable Lincoln Wire Feeders
Semi-Automatic: "-0" types .... LN-[illegible], LN-5
Fully Automatic: "-F" types .... LAF-3 & 5, LT-3 & 34

Standard 60 Cycle Input .... 3 phase, 230/460 volts **

Rated 60 Cycle Input Current ...... 156 amps (on 230 volts at 675 amp, 55 volt output).

Dimensions	Machine	Export Crate	
Height	36-3/8	41	
Width	55-5/8	63	
Depth	20	28	
Weights	**"-F" Types**	**"-0" Types**	**"-0F" Types**
Net	1454	1520	1526
Shipping, Domestic	1550	1580	1586
Shipping, Export	1683	1719	1725

*50 cycle SAF-600's (K-1216-F, K-1216-F and K-1216-0F) have output ratings of 600 amps, 55 volts at 60% duty cycle. Standard input is 3 phase, 220/380/440 volts **. Rated input current is 144 amps (on 220 volts at 600 amp, 55 volt output). They weigh 34 pounds more than 60 cycle models.

**Two-phase and other voltages available at extra charge.

DESCRIPTION

- o Heavy-duty DC motor-generator.
- o Provides both variable voltage and con[illegible] voltage output at separate studs.
- o "-F" types include field relay (reversin[illegible] required with full automatic heads and tr[illegible]
- o "-0" types include output contactor re[illegible] Squirt® welders.
- o "-OF" types include both field relay [illegible] contactor for full automatic or 'squirt' [illegible]
- o May be paralleled on variable voltage [illegible] high current submerged arc welding.
- o Provides auxiliary power for automatic controls.
- o Voltage Range Switch adjusts range of [illegible] voltage settings.
- o Welding current and voltage [illegible] controls in automatic equipment.
- o Polarity Switch.

LINCOLNWELD® SAF-600

'153

Lincolnweld SAF-600 is a versatile power source for all Lincoln DC full and semi-automatic welders and for stick electrode welding.

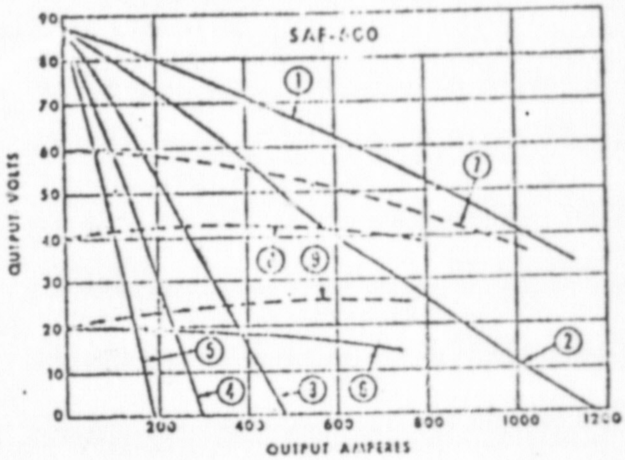
For Lincolnweld LAF-3 & 5 head and LT-3 & 34 tractors, it provides the variable voltage output used with submerged arc welding. It has the field relay ("-F" types) used by these welders to break welding current; leaves enough power for electrode inching. When two SAF-600's are paralled for submerged arc welding, one may be equipped with a 35-volt exciter to meet control power needs of the automatic welders. (When only one is used, a separate 35-volt MG-exciter is required. SAF-600's cannot be paralleled when constant voltage output is used.)

For LN-4 and LN-5 Squirt welders, SAF-600 provides the variable voltage output used with submerged arc plus the constant voltage output used with 'Innershield' self-shielded arc. It has the output contactor ("-0" types) used by these welders to break welding current, and all the control power they require.

SAF-600's circuitry accommodates remote output adjustment from the automatic welder's control panel. Output stud selection plus settings of open circuit voltage rheostat and voltage range switch determine range of control available at the automatic equipment.

TYPICAL OUTPUT CHARACTERISTICS

(60-cycle machines)



Settings for typical output characteristic curves shown above are:

Output Stud		OCV Rheostat	Voltage Range Switch
1. Variable Voltage,	450-Max	Maximum	High
2. Variable Voltage,	300-375	Maximum	High
3. Variable Voltage,	210-230	Maximum	High
4. Variable Voltage,	130-225	Maximum	High
5. Variable Voltage,	Min.-140	Maximum	High
6. Variable Voltage,	450-Max.	20 volts OCV	Low
7. Constant Voltage		60 volts OCV	High
8. Constant Voltage		Maximum	Low
9. Constant Voltage		20 volts OCV	Low

FEATURES

Pushbutton Starter Control operates heavy-duty contactor for across-the-line starting.

115-Volt Starter Circuit is available where required by plant regulations. (Standard machines use full input voltage in starter circuit.) (Optional at extra charge.)

Input Current Reducing Starter may be obtained to cut starting current to about one-half of normal amount. (Optional at extra charge.)

Output Contactor (Types "0" or "-0F") makes electrode electrically cold when not welding.

Reversing Type Field Relay (Types "-F" and "-0F") keeps fields warm while machine is idling to provide completely steady output from start to end of weld for submerged arc welding.

Current Adjustment can be remotely controlled from Lincoln automatic wire feeders.

Special Arc Gouging Protection against heavy current surges while arc gouging is available. (Optional at extra charge.)

Voltmeter and Ammeter available at extra charge.

Auxiliary Power supplies all needs for Squirt welder controls and all except 35-volt power for full automatic controls.

Separate Exciter supplies electrically independent excitation for steady output.

Automatic Overload Protection opens line contactor in case of high temperatures, overload, under-voltage, single-phase input, or locked rotor.

Safety-Zone Control Box has separate compartments for input power controls, and output terminals.

Welded Steel Lifting Hook provides convenient handling by cranes or fork-lift trucks.

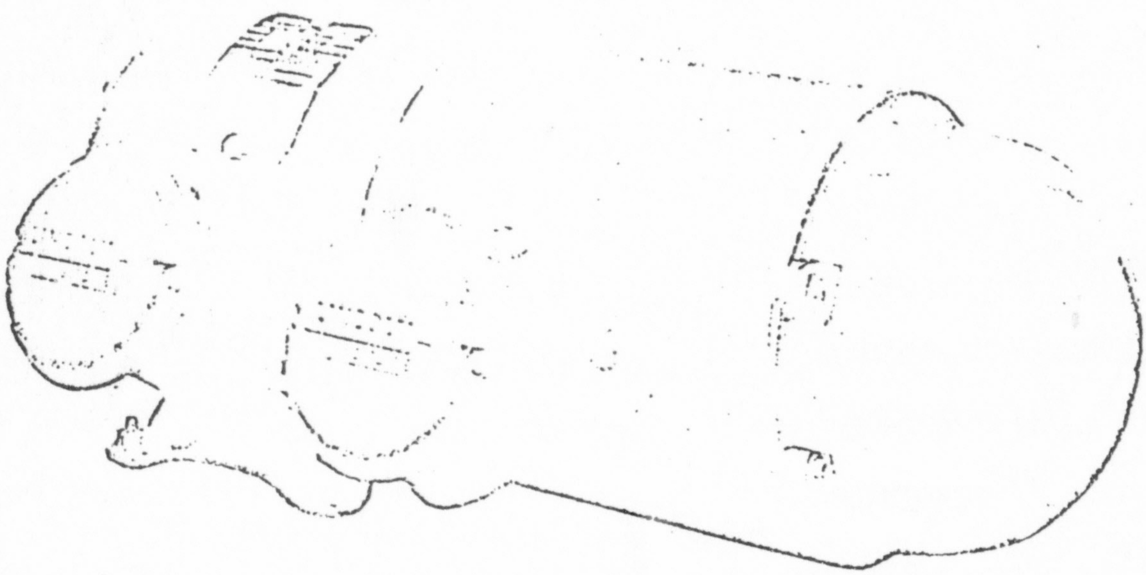
Rugged Polarity Switch is in field circuit.

Handy Terminal Strip at rear of machine provides connections for all automatic control leads. Electrode and ground terminals are on back or end of control box; separate electrode studs provided for variable and constant voltage outputs.

Easy Preventive Maintenance is assured by readily accessible [illegible] and bearings.

LINCOLN power sources

M-G CONTROL EXCITERS



Some Lincoln automatic welders require both 115 and 35 volt DC control power. The 115 volt power is supplied by the main power source and the 35 volt power is supplied by an M-G Control Exciter.

The M-G Control Exciter is a motor-generator with adjustable 0-35 volt DC output. The required 115 volt DC excitation power is supplied by the exciter on the power source. The generator leads are located in the conduit box and are tagged to agree with the wiring diagrams supplied with the automatic welders.

When two power sources are to be paralleled, one should be equipped with a 35 volt exciter to eliminate the need for a separate M-G Control Exciter.

SPECIFICATIONS

Type	K-1179	K-1178
Input Specifications:		
Cycles/Phase	60/3 or 2	50/3
Voltage *	230/460	230/380/440
Amps at Rated Load	3.4 @ 230V	2.1 @ 380V
External Excitation Req'd	0-130 volts DC	
Output Specifications:		
Voltage Range	0-35 volts	
Voltage at No Load	35 volts	
Voltage at Rated Load	30 volts	
Current Range	0-12 amps	
Current at Rated Load	9 amps	
Duty Cycle	100%	
Dimensions:		
Height – Width – Depth	8-7/8" x 23" x 8-5/8"	
Weights:		
Net	144 pounds	
Domestic Shipping	155 pounds	
Export Shipping	180 pounds	

* Other voltage available on special order.

THE LINCOLN ELECTRIC COMPANY

World's Largest Manufacturer of Arc Welding Equipment and Electrodes • Manufacturer of Motors Since

Cleveland, Ohio 44117 U.S.A.

Toronto, Ontario, Canada • Padstow, N.S.W., Australia • Grand-Quevilly, 76 – Fr

4/63

Printed in U.S.

LN-3 SQUIRT WELDER

The wire feeder to maximize your arc welding mechanization by giving you . . .

WIDE PERFORMANCE RANGE

Weld with a 50 to 500 imp wire feed speed; up to 600 amps DC; anywhere up to 60 feet from the wire reel mounting. Feed electrode wire (solid .035-3/32 inch or tubular .068-.120 inch), from 30, 50 or 60 pound coils. Spindle available for 10, 25 or 30 pound spools.

COMPACT — LIGHTWEIGHT

Module design permits independent positioning of each element. Place wire drive unit up to 45 feet from wire reel mounting. Place wire reel mounting up to 400 feet from the power source. Total wire feeder weight without wire is 80 pounds. Wire drive unit alone weighs 32 pounds.

TROUBLE-FREE WIRE FEEDING

Drive mechanism; motor, gear box and drive rolls, sized to give positive, trouble-free performance. Drive roll pressure easily adjusted.

UNLIMITED PROCESS SELECTION

Handles open arc or submerged arc processes with constant voltage or variable voltage performance. Easily connected to wide variety of power sources. Ready for today's job requirement changes and tomorrow's new process developments.

POSITIVE WIRE FEEDING

Wire feeder's solid state, mag amp control circuit instantly responds to variations in wire drag to give constant wire feeding.

Both feed rolls are powered by the helical-spur gear box. Non-fluid grease eliminates leaking and provides long time lubrication. Gear box can operate in any position.

Drive roll pressure is adjustable to give high force for feeding large diameter wire or low force to prevent buckling tubular or small diameter wire.

Unique design drive rolls will not mill or cut through wire.

Switch converts motor control circuit from constant feed speed, constant voltage performance to variable feed speed, variable voltage performance.

RELIABLE ARC STARTING

Inch speed control assures consistent arc striking — eliminates stubbing, [illegible]ping and excessive spatter at weld starts.

Optional Line-Fill low current starting circuit provides clean, positive starts when welding with long stickout procedures.

INCREASED ARC TIME

Wire drive unit is compact and lightweight — arrives at the job faster and is welding sooner.

Lightweight guns and cables — reduce operator fatigue and promote sustained, high-speed welding.

Current control on wire feeder eliminates [illegible] to travel back to power source to adjust or change [illegible].

Module design wire feed unit and wire reel mounting — permits separate placement of each for maximum convenience.

Positioned lifting ring — tips feeder forward when suspended to give more convenient working position.

Interlock switch — permits continuous welding w[illegible] holding gun trigger.

Rugged, simple construction — requires [illegible] to maintain continuous trouble-free performance.

FLUIDIZED FLUX FEEDING

Flux feeding system provides a constant flow of [illegible] flux for submerged arc welding.

One hundred pound flux tank capacity [illegible] work needs.

Operates on any compressed air line carry[illegible] to [illegible] psi pressure.

Built-in air filter traps moisture and other [illegible] before air enters tank — [illegible]

Flux system [illegible]

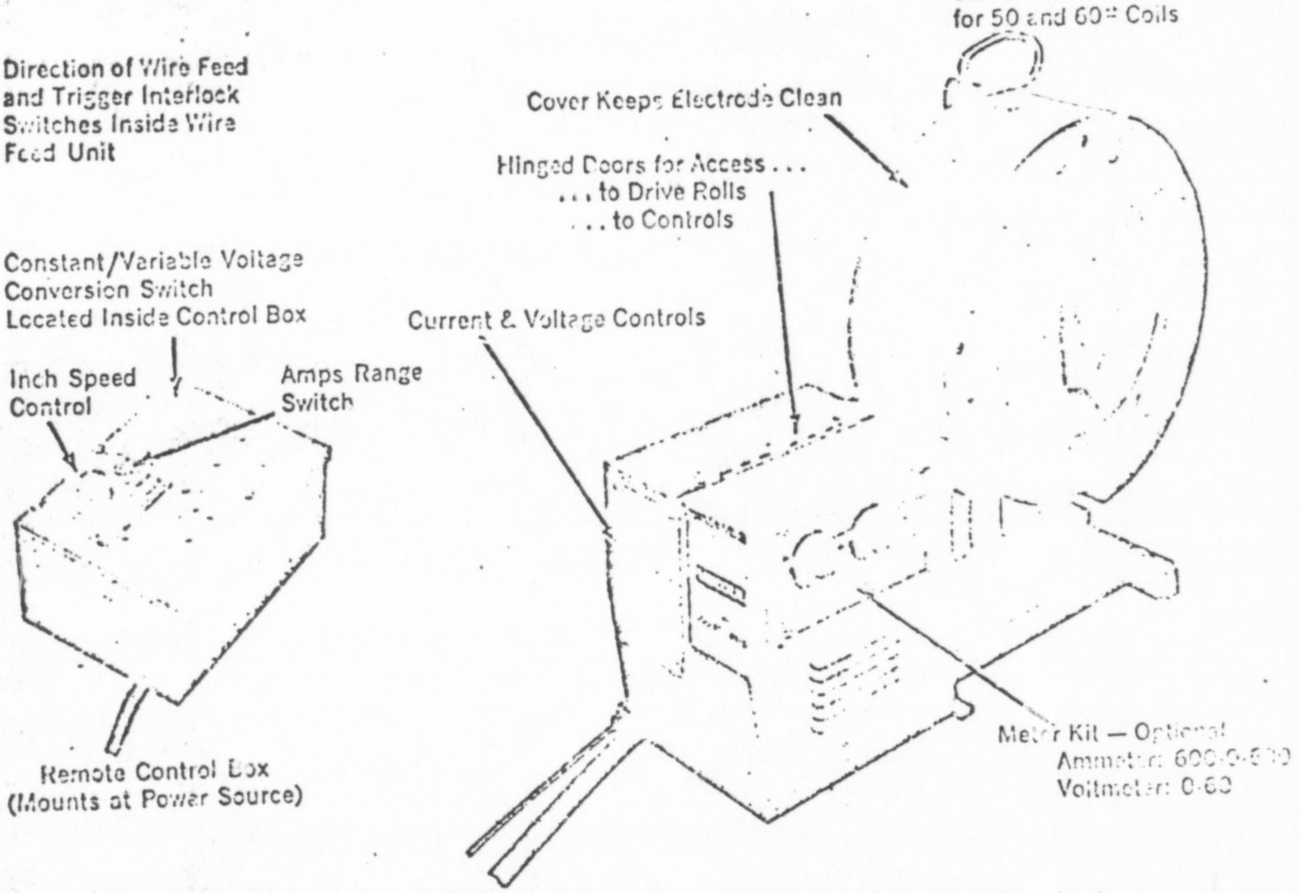
to [illegible]

®"Squirt" is a Lincoln Electric Company [illegible]

Choose the best model for your specific needs

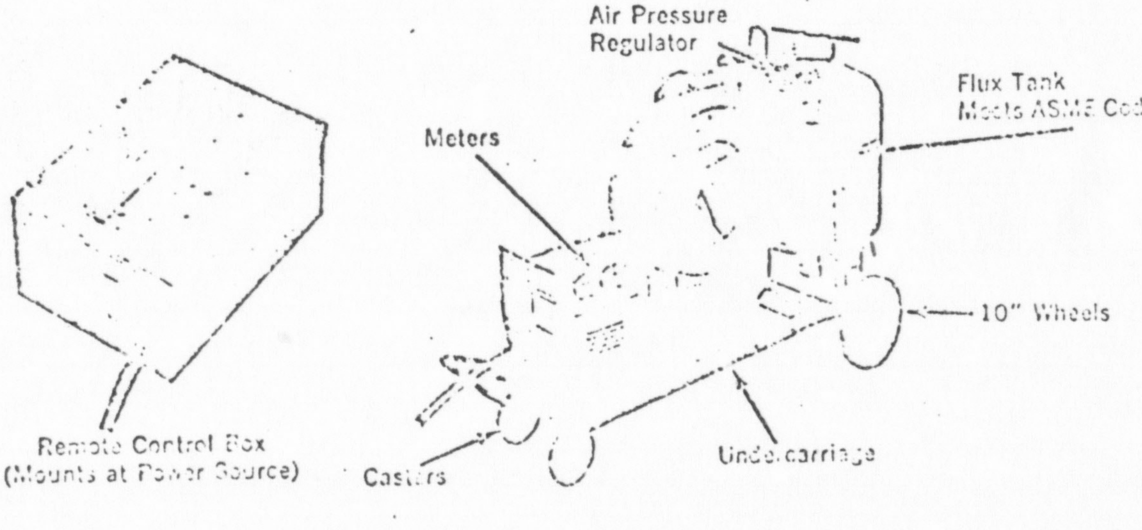
LN-6N

SQUIRT WELDER---For Innershield and other open arc processes. Also, for submerged arc welding using the K-119 flux cone.

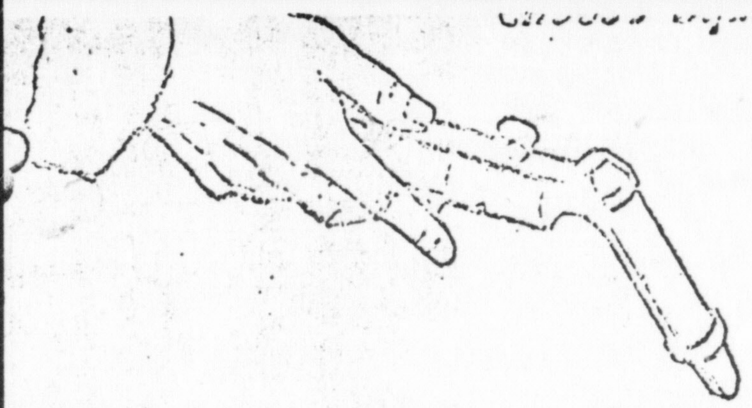


LN-6S

SQUIRT WELDER—For submerged arc with continuous flux feed, Innershield and other open arc processes. The meters, undercarriage and flux tank are standard equipment.



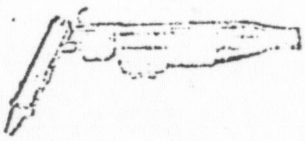
Models for welding up to 50' from w...



- Air cooled for light weight and maneuverability; facilitate sustained high speed welding.
- Compact for welding in confined areas.
- Simple but rugged for long life and easy service.
- Nozzle or gun easily replaced.
- Safe and convenient — the wire is electrically "cold" until the trigger is pulled.
- Low cost. 15' gun cable is included.
- Gun cables are changed in seconds — all have the same fitting at the wire feeder end.
- 50% duty cycle rating.

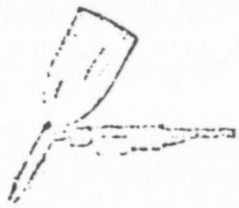
SUBMERGED ARC GUNS

K-112
350 ampere rating
For 1/16" wire

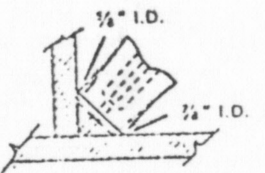


K-113
600 ampere rating
For 5/64" wire

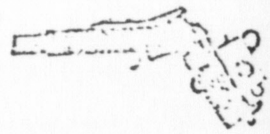
FLUX CONE (K-119)
fits K-112 and K-113 Squirtguns for welding without the Continuous Flux Feed system.



NOZZLE LOCATION in submerged arc guns is fixed so the wire exits at the exact center of the flux cone tip. This allows the operator to aim for good weld placement. Different diameter cone tips shipped with each gun minimize flash through and flux consumption regardless of weld sizes.



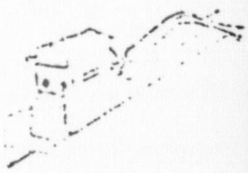
K-114
600 ampere rating
For 3/32" wire (can also be used for 5/64" wire)
Includes flux valve and receptacle for K-110 or 'Squirtmobile'.



MECHANIZED HAND TRAVEL UNIT (K-110)
carries K-114 Squirtgun along the joint at a preset travel speed to help the operator make better welds 10 to 25% faster. Speed range is 7-60 ipm.

FILLET GUIDE (K-70)
attachment simplifies horizontal fillet welding when using the Mechanized Hand Travel Unit (K-110).

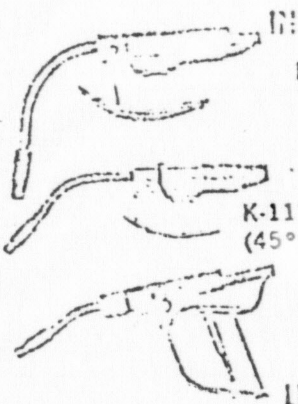
SQUIRTMOBILE®
is a self-propelled trackless carriage that carries submerged arc guns on long welds for automatic welder economy without high fixture costs. See page 6 for details.



INNERSHIELD® GUNS

K-115 & K-115-45
450 ampere rating
K-115-.120 for .120" wire
K-115-3/32 for 3/32" wire

K-116
600 ampere rating
K-116-.120 for .120" wire
K-116-3/32 for 3/32" wire
Has adjustable handle for greater versatility.

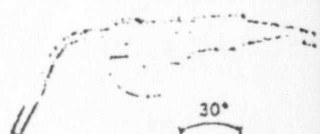


K-115

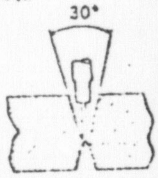
K-115-45
(45° Nozzle)

K-116

K-126
350 ampere rating
For 3/32 thru .068" wire

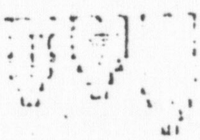


SMALL GUIDE TIP of all Innershield guns plus wire stickout reaches into deep grooves.



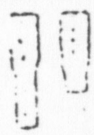
LINC-FILL® GUIDES

SUBMERGED ARC



These extension guides increase stickout to preheat the wire for up to 50% higher deposition rates. Appropriate guides are shipped with each gun.

'INNERSHIELD'



Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

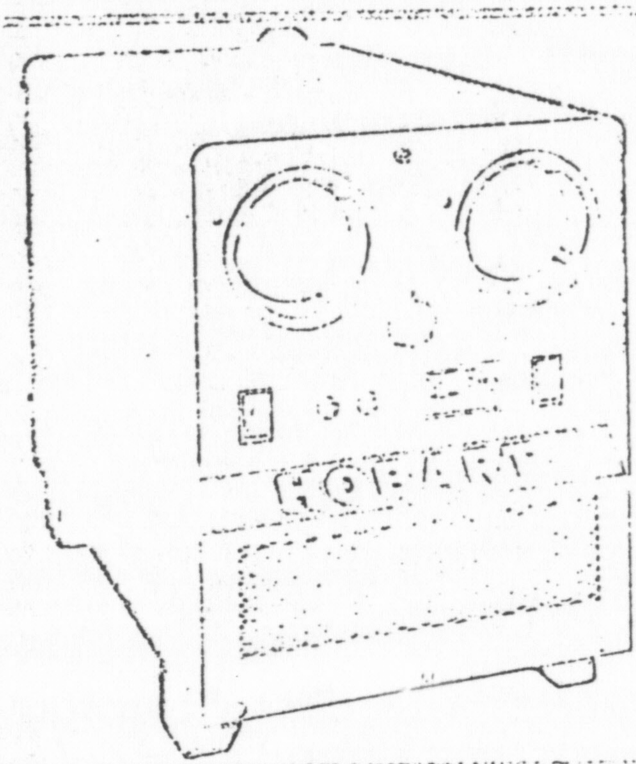
AC/DC MANUAL SHIELDED METAL ARC WELDING EQUIPMENT

Number of Units: Four

Manufacturer and Model: Hobart Model TR-300, or equal,
complete with power factor correction capacitors.

AC-DC Transformer-Rectifier Welder Combinations

REPLACES 6?. 20



ADVANTAGES

- Diverter Path Design
- AC-DC Selector and Polarity Switch
- No Moving Cores or Coils
- Improved Arc Stability
- Dial Type Current Control
- Current Adjustment Remains Easy throughout the years
- Silicon Rectifiers
- Primary Contactor
- Overload Protection
- Compact Case Design
- Lifetime Warranty on Hobart Power Diodes

ESSENTIAL DATA

MODEL	TR-300 AC	TR-300 DC	TR-500 AC	TR-500 DC
RATED OUTPUT—Amperes	300	300	500	500
—Volts	40	30	40	30
—Duth Cycle	60%	60%	60%	60%
—Welding Range—Amperes	50-375	40-375	50-625	40 625
MAXIMUM NO LOAD VOLTAGE	80	72	80	72
INPUT AT RATED LOAD:				
With Capacitors—At 208 volts—Amperes—Standard	102		186	
—At 230 volts—Amperes—Standard	92		168	
—At 460 volts—Amperes—Standard	46		84	
—At 575 volts—Amperes—Optional	37		68	
—Primary KVA	21.2		38.7	
Without Capacitors—At 208 volts—Amperes—Standard	121		215	
—At 230 volts—Amperes—Standard	110		196	
—At 460 volts—Amperes—Standard	55		98	
—At 575 volts—Amperes—Optional	44		78	
—Primary KVA	25.2		44.8	
EFFICIENCY AT RATED LOAD	83%	62%	80%	60%
KW INPUT AT RATED LOAD	14.5		25	
INPUT AT NO LOAD:				
With Capacitors—At 208 volts—Amperes—Standard	13		24	
—At 230 volts—Amperes—Standard	16		22	
—At 460 volts—Amperes—Standard	8		11	
—At 575 volts—Amperes—Optional	6		9	
—Primary KVA	3.7		5.1	
Without Capacitors—At 208 volts—Amperes—Standard	11		20	
—At 230 volts—Amperes—Standard	10		19	
—At 460 volts—Amperes—Standard	5		9	
—At 575 volts—Amperes—Optional	4		7	
—Primary KVA	2.3		4.2	
PRIMARY KW AT NO LOAD	0.6		1	
DIMENSIONS—Height	32		32	
—Width	21¾		21¾	
—Depth	30		30	
NET WEIGHT	550		735	
ADD FOR CAPACITORS	7		10	

YOUR CHOICE OF AC OR DC FOR GENERAL ARC WELDING

Here is the com[illegible] Transformer and [illegible] that lets you cho[illegible] method for every [illegible] welding job, [illegible] or Straight or [illegible] DC.

TRANSFORMER: Redesigned Hobart "Diverter Path" type to give improved arc performance — particularly with less stable electrode types. Secondary coils are spaced away from primary, eliminating chance of line voltage appearing in welding circuit.

Diverter path design allows no high voltage to be induced in the control coils and hence difficulties with these coils are virtually non-existant.

NO MOVING COILS OR CORES: Hobart "Diverter Path" design permits all cores and coils to be firmly anchored — core is actually welded together, tending to make a quieter unit than those types which do have moving cores front panel.

DIAL TYPE CURRENT CONTROL: Current control is accomplished with a 5 range switch, with rheostat for fine control, making this the easiest AC-DC welder to adjust.

CONTROL OF WELDING CURRENT REMAINS EASY THROUGH THE YEARS: The dial type adjustment is far less affected by dirt and aging effects than mechanically controlled welders. The rheostat in particular is nearly impervious to the effects of dirt and drying which clog mechanical adjustments.

MINIMUM ARC BLOW: Hobart AC-DC welders are designed to help minimize arc blow. Use DC welding current where control of penetration and other desirable DC arc characteristics are desired. If arc blow is encountered, simply switch to AC.

EASY ARC STRIKING: High open circuit voltage results in inherent easy arc striking characteristics. Also provides a smoother, more stable arc, as is required when using low hydrogen electrodes. It eliminates the need for troublesome extra devices for "boosting the arc," as are required on some welders, while at the same time providing superior performance.

HIGH EFFICIENCY—LOW OPERATING COST: The high electrical efficiency holds the power costs to a minimum, making this the least expensive welder to operate. No load losses are minimum, also.

AC-DC SELECTOR AND POLARITY SWITCH: The 3-Way Switch on the control panel makes it easy to set the unit for welding with AC or with either straight or reverse polarity DC.

SILICON RECTIFIER: This Hobart AC-DC welder makes use of the most modern rectifying means known -- silicon diodes. Silicon diodes offer many advantages over other types of rectifiers, such as:

(1) Silicon diodes are the most efficient rectifiers known. Their use in a welder results in a substantial reduction in electric power consumption.

(2) Silicon diodes are hermetically sealed, making them nearly impervious to the effects of salt air and most industrial fumes.

(3) Silicon diodes are not as sensitive to dirt as selenium rectifiers. Because there are no closely spaced fins, clogging with dirt is unlikely.

(4) Silicon diodes do not age. Efficiency remains high through a diode's life, unlike that of selenium rectifiers.

(5) Silicon diodes do not "unform" with disuse, as do selenium rectifiers. Silicon diodes do not fail when first energized after long periods of idleness. This means during periods of inactivity you can store your welder with no special procedures being required when restoring it to service.

(6) Silicon diodes are easily replaced as individual components of a rectifier assembly. This results in a major reduction of maintenance costs.

(7) Silicon diodes are mechanically more rugged than selenium rectifiers. Chances of damaging during handling and storage of spare parts are reduced.

TOTALLY ENCLOSED, PERMANENTLY LUBRICATED FAN MOTOR: The fan motor in this welder is designed for thousands of hours of attention-free operation. No lubrication is required. Its totally enclosed construction makes it nearly free of the effects of dirt, fumes, and corrosive atmospheres such as salt air.

The fan is an exhaust type, with air intake at the front and rear of the case.

GENERAL CONSTRUCTION: Characteristically Hobart in ruggedness and long life expectation. Cabinet of pressed steel. Removable top and sides permit access to all components. Case design permits units to be stacked by using supplemental rails available when requested on purchase order.

CONNECTIONS: Access to power connections is obtained by removing the top, held by six screws in slotted holes. A strain relief connector is provided at the hole in the rear panel through which power leads are intended to pass.

OPERATING CURRENT: Single phase, 208/230/460 volts, 60 cycles is standard. See price list 331-A for other voltages and combinations available.

OVERLOAD PROTECTION STANDARD: An overload device automatically turns welder off.

PORTABILITY: Sturdy lifting eye makes it easy to handle by means of crane or hoist. A portable mounting is also available at nominal extra price.

POWER FACTOR CORRECTION: Power factor correction capacitors are optional. See data on reverse side of this sheet.

PRIMARY CONTACTOR: Primary contactor is push button operated.

OPTIONAL EQUIPMENT: See other data sheets and price lists applying to:

- Capacitors for Power Factor Correction
- Variac Type Remote Control
- 115 Volt Push Button Safety Circuit
- Portable Mounting
- Cables, Shields, Electrode Holders
- Clothing and Other Useful Accessories
- Arc Welding Electrodes for All Purposes

INDUCTION STRESS RELIEVING UNIT

Number of Units: One

Manufacturer and Model: Electric Arc, Inc., Model CGSF - 10 or equal

Power Supply: 120 KVA power supply consisting of two sections, each rated at 80 volts and 750 amperes

Control: Six - point, strip type, recorder - controller unit. Variable set point, high temperature shut - off cuts off power when any of the six temperature points exceeds the set point. Temperature range 100 - 1800° F. Programming unit controls rate of temperature rise, holding temperature and rate of temperature drop.

Capacity: 40" outside diameter by 4" average wall chrome alloy steel pipe weld at 1375° F.

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

PIPE CUTTING AND BEVELING EQUIPMENT

Number of Units: As noted below

Manufacturer: H & M Pipe Beveling Machine Co., or equal,

Pipe Cutting and Beveling Equipment as follows:

One (1) Machine #1

One (1) Machine #2

One (1) Machine #3

One (1) Machine #4

One (1) Machine #30

One (1) Bevel Land Grinder

One (1) Shape Cutter Attachment

Two (2) Torches, Smith Model SC792A-SC31-C-4

H&M®

PIPE CUTTING AND BEVELING MACHINE

FOR CUTTING AND BEVELING PIPE FROM 1½" THROUGH 48" IN DIAMETER

Designed to cut pipe from 1½" through 48" in diameter, H & M Machines are lightweight, rugged and give speed, accuracy and economy under the toughest conditions. You take H & M Machines to the job, not the job to the machine.

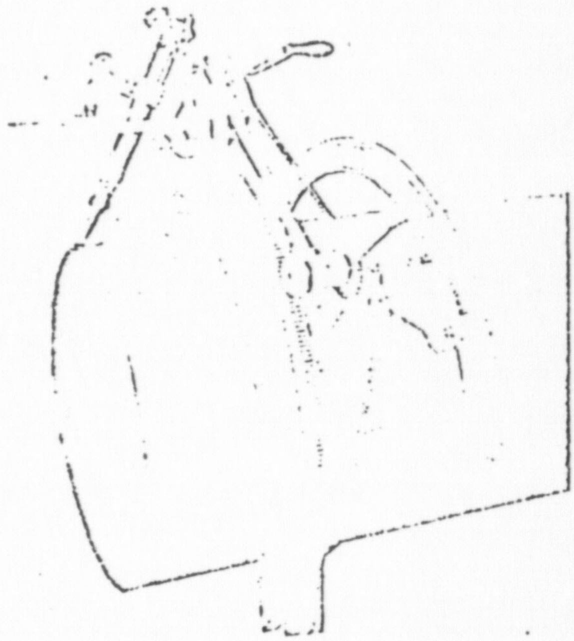
The new short saddles are ideal for cutting and beveling in tight locations, without changing the basic design or obsoleting any of the machines presently in use. The rear mounted saddle of cast aluminum reduces the possibility of heat warping, especially in back beveling operations.

The split horseshoe principle of H&M Machines permits the machine to slip easily over the section of pipe to be cut. Quick operating snap-fasteners hold the machine securely to the pipe, and after the torch has been lighted, a few revolutions of the crank complete the operation. A complete 360° revolution, cutting and beveling to any angle, can be made without stopping or repositioning. For example, Machine No. 5 can completely cut and bevel a 36 inch pipe in about 5½ minutes.

With a few minutes of instruction on an H&M, anyone who can handle a cutting torch can make perfect cuts and bevels of any size. The one-man operation quickly saves several times the cost of the machine in labor and gas, in comparison to hand cutting. In about half the time, even unskilled operators working in the field can make accurate cuts with fewer rejects.

Complete light metal fabrication insures portability and ruggedness that withstand the most demanding job conditions. The aluminum ring gear assembly is completely hard anodized to reduce wear to an absolute minimum. This hard anodizing process, along with H&M's precision engineering and machining, guarantees the most accurate and "long-lived" pipe beveling machine available!

The advantage of quick, easy and economical replacement of any part on an H&M unit gives added years of use and profit



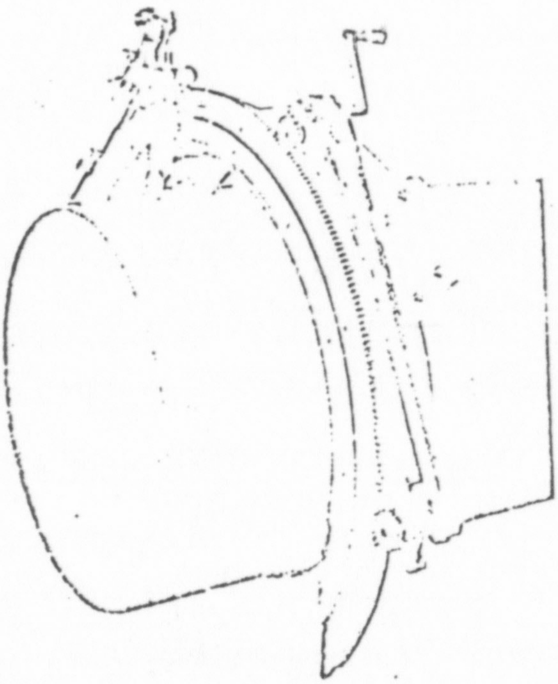
NO MACHINE NOW IN USE IS OBSOLETED BY THE NEW SHORT SADDLE

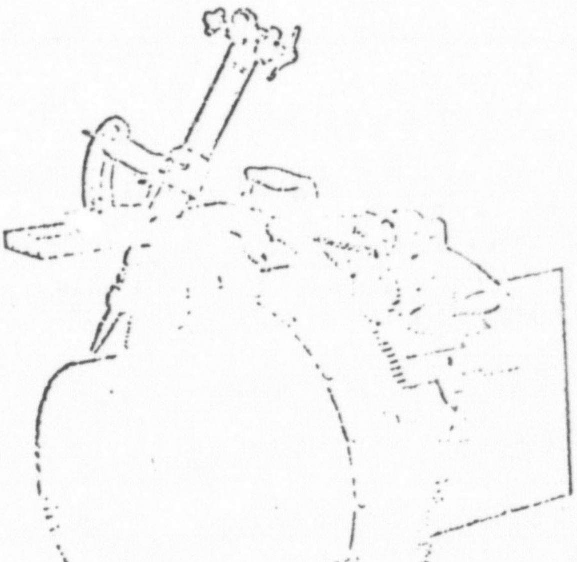
Utilization of the same specifications for bolting the saddle to the ring gear makes it possible for all H & M Machines to be easily and economically converted to the new short saddle. Spacer bolts on machine #1 are now 4⅞" on center; machine #2, 5⅞"; machines no. 3, 4, 5 and 30, 6⅞". These reductions of operating space requirements broaden the use of beveling machines into fields where space has previously been a problem.

The machine is designed for straight cutoff, with bevels at any angle. If your pipe fabrication job requires T's, Y's, elbows, saddles or joints at various angles, the H & M Shape Cutting Attachment is indispensable. These attachments fit all sizes of H & M Beveling Machines and separate catalog sheets are available on each unit.

H & M manufactures a complete line of pipe cutting and beveling machines with a range of 1½" to 48". Catalog sheets available on request.

. . . IN SIZES TO MEET YOUR NEEDS





Machine no. '0'
Cuts 1½" through 4" — weight: 7½ lbs.

Machine no. 1
Cuts 4" through 8" — weight: 13 lbs.

Machine no. 2
Cuts 8" through 12" — weight: 23 lbs.

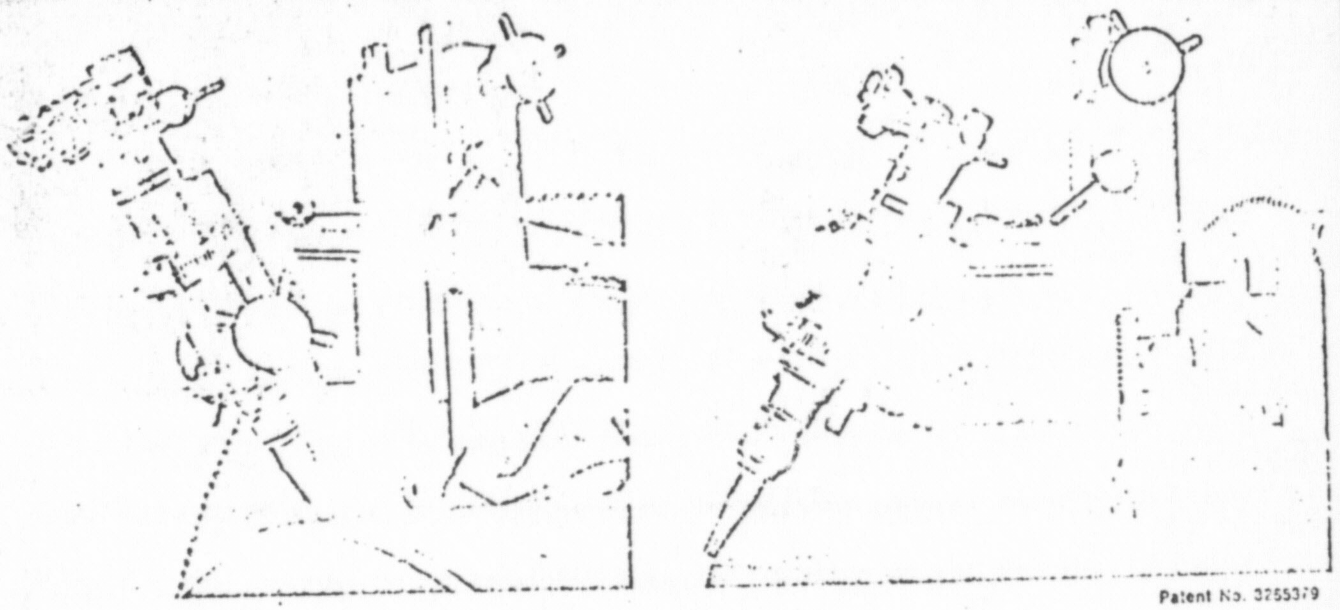
Machine no. 3
Cuts 14" through 20" — weight: 51 lbs.

Machine no. 4
Cuts 22" through 26" — weight: 65 lbs.

Machine no. 30
Cuts 26" through 30" — weight: 80 lbs.

Machine no. 5
Cuts 26" through 36" — weight: 88 lbs.

Machine No. 6
Cuts 42" through 48" — weight: 200 lbs.



Patent No. 3255379

MODEL "B" OUT-OF-ROUND ATTACHMENT

THE ONLY TRULY ACCURATE OUT-OF-ROUND ATTACHMENT

The new MODEL "B" OUT-OF-ROUND ATTACHMENT fits all H&M Pipe Beveling Machines, sizes 1 through 6, for pipe 4" through 48" diameter. Special adaptations can be made to fit the H&M Model "O".

A new horizontal adjustment feature allows movement over a 1" span, permitting the operator to make adjustments without moving and resetting the machine. This also eliminates "blow holes," as the cut can now be started outside the intended line of the cut and the torch moved horizontally to the cut line.

A Positive Setting on the degree of the bevel **can be had** each time by a simple lock-pin arrangement. Merely unlock the protractor, move to the desired angle on the scale, and the pin automatically locks into position.

The back beveling operation can now be accomplished without adding an "angle head" attachment as has been necessary in the past. The use of either short or long torches is also now possible without making any special adaptation to the machine.

The extreme accuracy of past H&M Out-of-Round Attachments is retained completely. This is accomplished by the perfect longitudinal alignment of torch, wheel and spring. This hard anodized unit is completely machined with the spring enclosed. It is made like a lathe, with all sliding parts dovetailed and take-up gibs utilized for complete accuracy and long life.

No wrenches or tools are necessary for operation, as all adjustments are made with a rack and pinion arrangement. Even the stainless steel torch clamps are hand adjustable. The vertical and horizontal adjustments are made by simply turning a knob.

The roller rides the surface of the pipe under spring tension, and automatically makes corrections for any imperfections of out-of-roundness of the pipe.

H M

E-M "BEVEL LAND" GRINDER

for...
fast cleaning of pipe cuts—
accurate placing of the
land on bevels

Patent No. 2,857,293

The new "BEVEL-LAND" GRINDER is designed to eliminate the old, time-consuming method of using a file and hammer or hand grinder to smooth pipe cuts and place the land on bevels. The machine uses an electric or air powered grinder to do this job quickly and accurately.

The "BEVEL-LAND" GRINDER is fast and simple to operate . . . requires no special training. The machine is designed to clean pipe cuts and bevels in one fast, simple operation. It adjusts in a matter of seconds into position to place the land on the pipe bevel.

The Grinder is light and portable. It is designed for easy, fast mounting and may be placed in the pipe and locked in place in a matter of seconds. The machine works equally well on all types of metals . . . steel, stainless steel, high alloy steel and aluminum pipe.

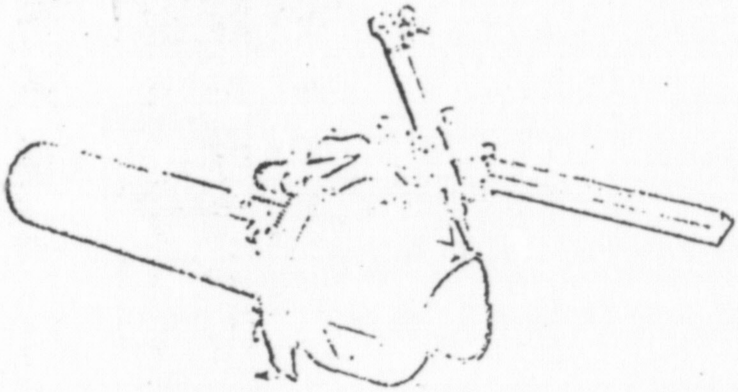
FOR 3" to 32" PIPE

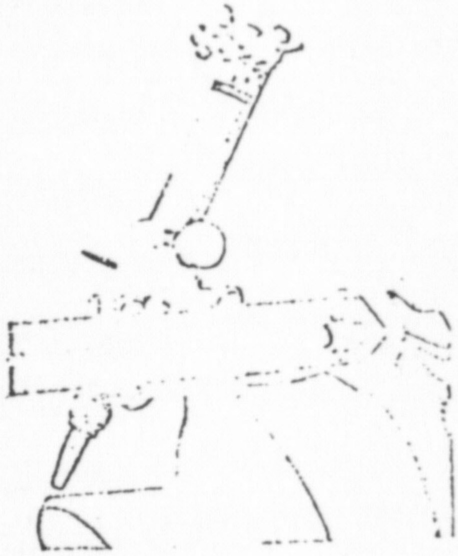
The "Bevel-Land" Grinder is designed for use on pipe from 3" to 32" in diameter. Three models are available:

Model 36--3" through 6" pipe
Model 612--6" through 12" pipe
Model 1130--11" through 32" pipe
Larger models are also available.

SHAPE CUTTER
PERFECT FOR PIPE FABRICATION

The new H & M Shape Cutting Attachment offers many refinements over previous models, advancing the state of the pipe cutting art. *Now—for the first time—uniform cutting torch movement around the template is assured even at angles up to 45 degrees.* H & M's enclosed negator spring maintains equal tension between the template and the cutting torch carriage at all times. Lateral stability of the torch is secured through the triangular design of the hard-anodized travel tube and the six carriage roller bearings which permit the torch to travel smoothly and evenly in the longitudinal plane through the complete 360 degree revolution.





CONTROLLED CUTTING

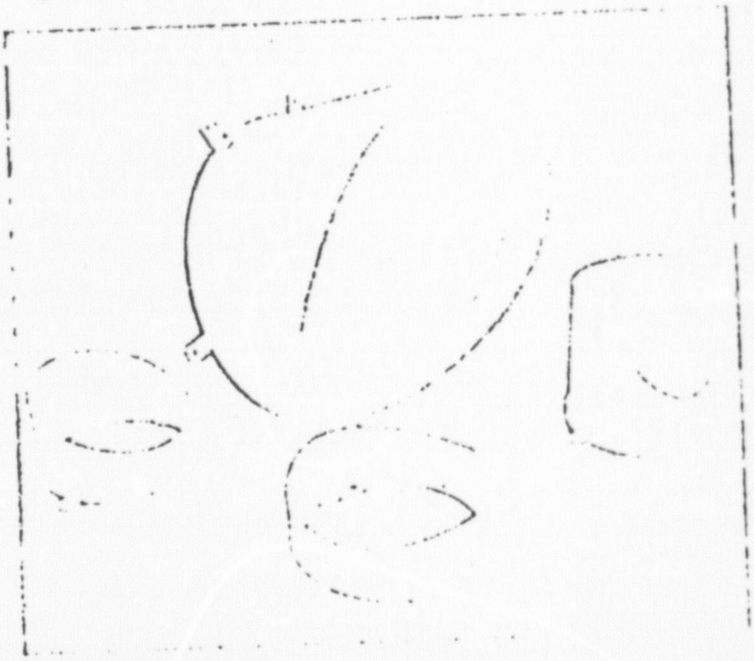
The H & M Shape Cutting Attachment performs a task that even the most skilled hand cannot duplicate—*it controls the movement of the cutting torch* by means of pattern templates in cutting various shapes of pipe intersections preparatory for welding—saddles, tees, els or whatever design is needed.

ELIMINATES 'GUESS-WORK'

The "guess-work" in intersectional cutting is completely eliminated with the H & M Shape Cutter, and the joint is ready to be put in place for welding in a matter of minutes. Light and portable, the Shape Cutter is available in the same full range of sizes as the pipe cutting and beveling machines.

TEMPLATES AVAILABLE IN ALL SIZES AND SHAPES

The proper template, such as those pictured below, is placed on the machine and the desired cut is made from a proven pattern. A blueprint and one template are included with each unit to enable users to make other templates as needed.



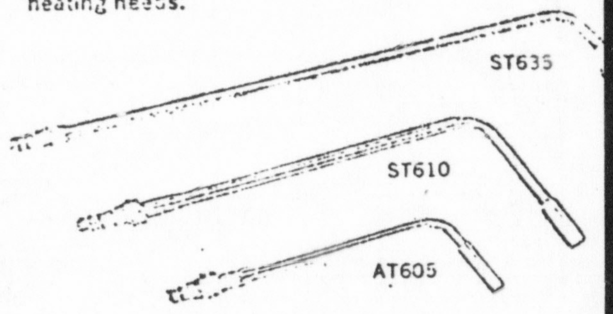
HEATING TIPS NWSA 220

Smith's®

Torch Bodies Used In	Average BTU's Output	Fuel Gas	Smith's Number
SW1, SW2, and SW10	71,650	Acetylene—Medium Pressure	ST603
	124,671		ST605
	194,888		ST610
	244,000	Propane—Medium Pressure	ST615
	485,000		ST625
	111,000	Natural Gas—Medium Pressure	ST615
	307,000		ST625
	98,000	Low-Pressure Natural Gas	ST630
	421,000	MAPP—Medium Pressure	ST615
SW10 Only	765,000	Propane—Medium Pressure	ST635
	367,000	Natural Gas—Medium Pressure	ST635
	179,000	Low-Pressure Natural Gas	ST640
	865,000	MAPP—Medium Pressure	ST825
MW5	40,125	Acetylene—Medium Pressure	MT603
	73,080		MT605
	128,970		MT610
	266,000	Propane—Medium Pressure	MT615
	166,000	Natural Gas—Medium Pressure	MT615
AW1	41,555	Acetylene—Medium Pressure	AT505

Fast, Efficient Heating with Smith's High Capacity Heating Tips

Smith's multi-flame heating tips save you money by heating fast; save labor costs. Designed to provide large volumes of heat for pre-heating, brazing, hard surfacing, shrinking, bending, straightening, forming and many other similar jobs. Tip heads are heavy wall copper construction for greater resistance to reflected heat. A large selection of capacities is available to suit a wide range of heating needs.

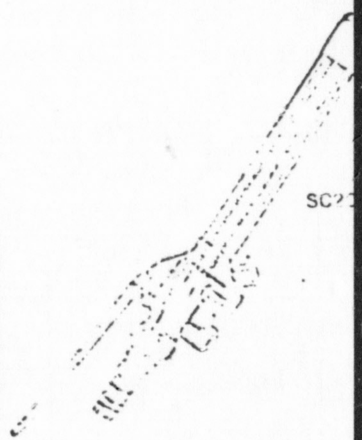


CUTTING ASSEMBLIES

Quickly Convert Smith's Torch Bodies To Cutting Torches

Solid silver brazed construction. All Smith's cutting assemblies feature "O" ring seating, special *Flo-Trol* safety protection, and easy to change *Slip-In* cutting tips. See the cutting tip section of this catalog for a complete selection of cutting tips, rivet cutting, plate cutting, metal washing, gouging and other special purpose tips.

Torch Bodies Used With	Smith's Number	Head Angle	Length	Cutting Capacity
SW1, SW2, SW10 Silver Star	SC205	75°	12½"	Up to 6" Steel
	SC209	90°	12½"	
	SC505	75°	12½"	
	SC509	90°	12½"	
MW5 Pipeliner	MC505	75°	11¾"	Up to 3" Steel
	MC509	90°	11½"	
	MC409	90°	9⅝"	
AW1 Airline	AC305	75°	8½"	Up to 1½" Steel
	AC309	90°	8½"	



CUTTING TORCHES

Smith's Hand and Machine Cutting Torches

Rugged construction, plus the latest technological know-how make Smith's Silver Star and Tuf Tony cutting torches the most efficient, money saving flame cutting equipment available today. Hand and machine torches available in medium pressure or injector models. All hand cutting torches equipped with replaceable hose connections after October, 1969. All feature Smith's quick change slip-in tip design. See the cutting tip section of this catalog for Smith's wide selection of cutting and special purpose tips.

HAND CUTTING TORCHES

Line	Smith's Number	Head Angle	Length	Cutting Capacity
Silver Star Medium Pressure	SC175	75°	17"	Up to 12" Steel
	SC179	90°	17"	
	SC225	75°	20"	
	SC[illegible]*	75°	20[illegible]	
	S[illegible]	90°	20[illegible]	
	SC[illegible]*	90°	20[illegible]	

Line	Smith's Number	Head Angle	Length	Cutting Capacity
Silver Star Injector	[illegible]	75°	17"	Up to 10" Steel
	[illegible]	90°	17"	
	[illegible]	75°	20[illegible]	
	[illegible]	90°	20[illegible]	
Tuf Tony Medium Pressure	SC725	75°	21"	Up to 24" Steel
	SC729	90°	21"	

*Smith Silver Star Hand Cutting Torches with special stainless steel heads.

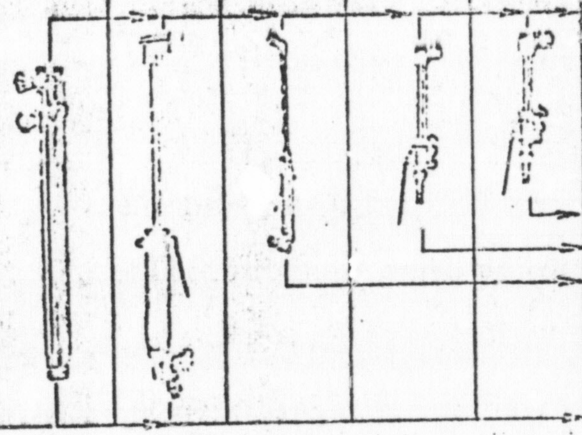
MACHINE CUTTING TORCHES [illegible]

Type	Smith's Number	[illegible]	[illegible]	[illegible]	Length	Type	Smith's Number	[illegible]	[illegible]	[illegible]	Length
Medium Pressure	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Injector	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

MEDIUM PRESSURE "SC" CUTTING TIPS

MACHINE CUTTING TORCHES	HAND CUTTING TORCHES		CUTTING ASSEMBLIES	
	"Tuf Tony"	Silver Star	Silver Star	Pipeliner
SC780A SC781A SC782A	SC725 SC729	SC225 SC225S SC229 SC229S	SC335 SC339 SC535 SC539	MC409



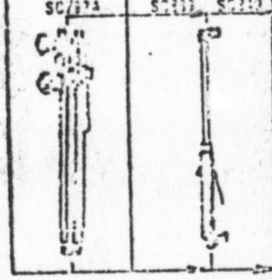
Highest Quality Swaged Construction

Smith's oxy-acetylene cutting tips are swaged from high quality copper to assure smoothest possible gas passages and fastest, most efficient cutting. All Smith's cutting tips feature Slip-In design, protected recessed seats and the extra safety of in-tip mixing.

CUTTING RANGE	ACETYLENE 4 Preheats	ACETYLENE 5 Preheats	ACETYLENE Heavy Preheat	PROPANE 1 Piece	PROPANE 2 Piece	PROPANE Hi Speed Mach. Cut	MAPP® 1 Piece	MAPP® 2 Piece	MAPP® Hi Speed Mach. Cut
⅛"-¼"		SC12-00	SC55-00		SC50A-00		SC55-00	SC50A-00M	
¼"-½"	SC10-0	SC12-0	SC55-0		SC50A-0		SC55-0	SC50A-0M	
½"-¾"	SC10-1	SC12-1	SC55-1	SC45-1	SC50A-1	SC21A-1	SC55-1	SC50A-1M	SC21A-1M
¾"-1¼"	SC10-2	SC12-2	SC55-2	SC45-2	SC50A-2	SC21A-2	SC55-2	SC50A-2M	SC21A-2M
1½"-2"	SC10-3	SC12-3	SC55-3	SC45-3	SC50A-3	SC21A-3	SC55-3	SC50A-3M	SC21A-3M
2½"-4"	SC10-4	SC12-4	SC55-4	SC45-4	SC50A-4	SC21A-4	SC55-4	SC50A-4M	SC21A-4M
5"-8"	SC10-5	SC12-5	SC55-5		SC50A-5	SC21A-5	SC55-5	SC50A-5M	SC21A-5M
10"-12"		SC12-6	SC55-6		SC50A-6	SC21A-6	SC55-6	SC50A-6M	SC21A-6M
14"		SC12-7	SC55-7		SC50A-7		SC55-7	SC50A-7M	
15"-18"			SC55-8		SC50A-8		SC55-8	SC50A-8M	
20"			SC55-9		SC50A-9		SC55-9	SC50A-9M	
21"-24"			SC55-9						

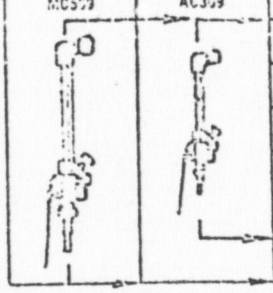
CUTTING TIPS for LOW PRESSURE NATURAL GAS

SC780A SC781A SC782A	SC335 SC225 SC339 SC229	Cutting Range	General Hand & Machine Cutting	Fast Preheat
		⅛"-¼"	SC31-00	
		¼"-½"	SC31-0	
		½"-¾"	SC31-1	SC28-1
		¾"-1¼"	SC31-2	SC28-2
		1½"-2½"	SC31-3	SC28-3
		3"-4"	SC31-4	SC28-4
		5"-8"	SC31-5	
		10"-12"	SC31-6	

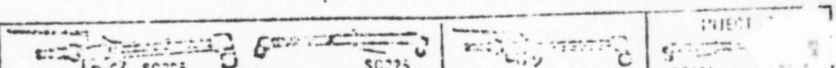


CUTTING TIPS for AIRLINE and PIPELINER Cutting Assemblies

MC505 MC509	AC305 AC309	Cutting Range	4 Preheats	5 Preheats
		⅛"-¼"	MC10-00	
		¼"-½"	MC10-0	
		½"-¾"	MC10-1	
		¾"-1"		MC12-2
		1½"-2"		MC12-3
		2½"-3"		MC12-4



SPECIAL PURPOSE CUTTING TIPS



APPLICATION	CAPACITY	MC409 SC335 SC339 SC535 SC539 Acetylene	SC735 SC739 LP-Gas	SC225 SC225S SC229 SC229S MAPP®	MC505 MC509 AC505 AC509 Acetylene	INJECT[illegible] SC375 SC539 SC5[illegible] Low Pressure Natural Gas
Gouging	¼" Deep x ⅜" Wide ½" Deep x ¾" Wide	SC13-3 SC13-5	SC23-3 SC23-5	SC23-3M SC23-5M	MC13-3	SC33-3 SC33-5
Rivet Cutting	¾" Rivets 1½" Rivets	SC14-1 SC14-3	SC24-1 SC24-3	SC24-1M SC24-3M	MC14-1	SC34-1 SC34-1
Rivet Blowing and Metal Washing	[illegible] [illegible]	SC15-1 SC15-2	SC22-1 SC22-2	SC22-1M SC22-2M	MC15-3	SC35-1 SC35-2
Riser Cutting	2"-5"	SC16-4				
Plate Cutting	[illegible] ¼" ¾"-1¼"	SC17-00 SC17-0 SC17-2		SC17-0M	MC17-00 MC17-0 MC17-2	
Flue Cutting [illegible]	Up to 2"	SC[illegible]-3				
Flue Cutting [illegible]	Up to 2"	SC[illegible]-3				
[illegible]	[illegible]	SC[illegible]				
[illegible]		SC[illegible]	SC[illegible]	[illegible]		[illegible]

PIPE BEVELING MACHINE

Number of Units: Two

Manufacturer and Model: H & M Pipe Beveling Machine Company, Inc., Pipe-End Prep Lathe, or equal

Type: Pipe end chuck with rotating cutting head

Capacity: All pipe diameters from 4" to 36"

Operations: Facing, Beveling, Boring and Grooving

Crippen Pipe Fabrication Corporation

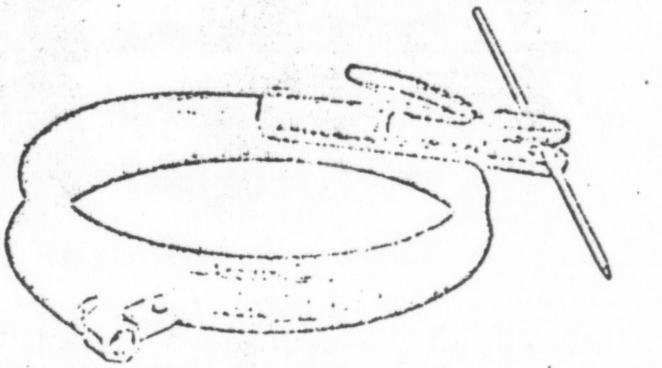
INDUSTRIAL PIPE BENDING AND FABRICATION

ELECTRIC ARC CUTTING EQUIPMENT

Number of Units: One

Manufacturer and Model: Arcair Model K-3 Cutting Torch, or equal

STANDARD TORCHES

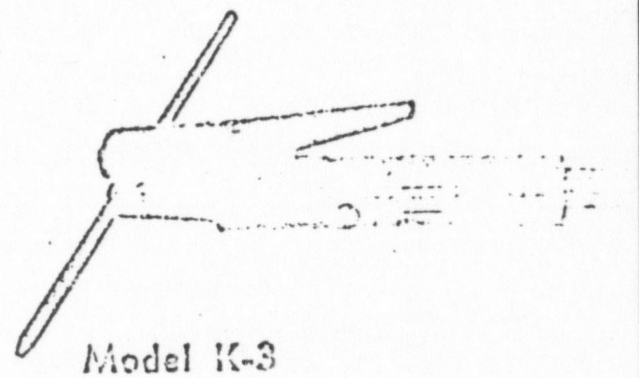


Model H-2

(Catalog No. 61-042-C01)

USE: Light, intermittent work. Body shops. Sheet metal shops. Farms, ranches. Not recommended for continuous use in industry. Rotating head with 2 air holes requires 80 to 100 p.s.i. Model H-2 is an excellent tool to complete the repair and maintenance facilities of the smaller shop. Steel sleeve on handle provides added strength. Rotating head with 1 air hole is also available, and can be used with 40 p.s.i.

SIZE: Takes 5/32", 3/16" and 1/4" electrodes.

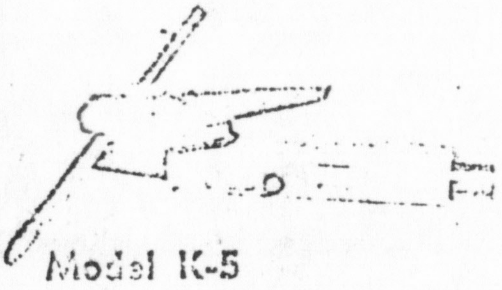


Model K-3

(Catalog No. 61-064)

USE: General purpose torch in use throughout industry. U[illegible] fabricators, tank shops, shipyards, etc., for weld pre[illegible] removing defective welds. The ideal tool for construction[illegible] quarries, contractors; chemical, food and petroleum plan[illegible] steel and paper mills, other heavy industry. Model K-3 [illegible] for either continuous production or intermittent maint[illegible] repair. Single rotating head with 3 air holes. All-around t[illegible]

SIZE: Takes 5/32", 3/16", 1/4", 5/16" and 3/8" electro[illegible]

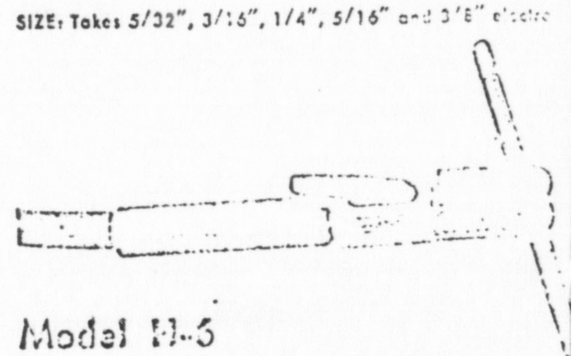


Model K-5

(Catalog No. 61-101)

USE: Heavy duty torch primarily used by foundries and steel fabricators. Same design as Model K-3, except it is of heavier construction, takes larger electrodes, and delivers more air. Removes larger amounts of metal, and is used as a continuous production tool. Single rotating head.

SIZE: Takes 5/16", 3/8", 1/2" and 5/8" electrodes.



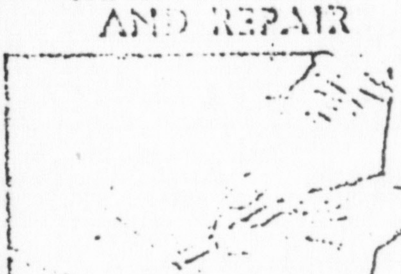
Model H-6

(Catalog No. 61-122)

USE: Model H-6 is of same design as H-3 and H-5, [illegible] very heavy construction for use with electrodes up to [illegible] ameter. Primary users are foundries and heavy plate f[illegible] rugged production tool. Single rotating head.

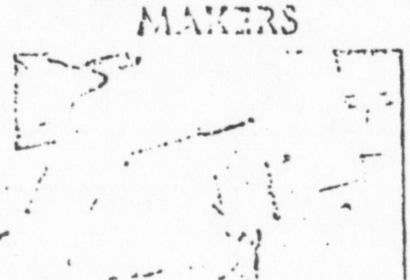
SIZE: Takes 3/8", 1/2", 5/8" and 3/4" electrodes.

MAINTENANCE AND REPAIR



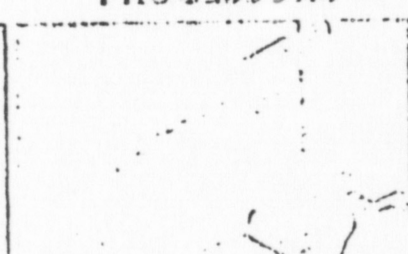
This Arcair Torch removes welds, gouges out cracks for rewelding, flush-cuts rivets and bolts. Cuts, gouges, pierces ALL metal — FAST.

MACHINERY MAKERS



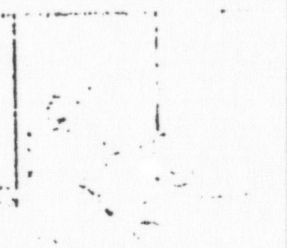
Gouging out 3" x 4" x 30" section of cast iron frame which has been cast [illegible]. Twenty [illegible] castings saved.

FOOD PROCESSORS



Gouging out [illegible]

DISMANT[illegible]



Arcair T[illegible]

PIPE POSITIONER - A

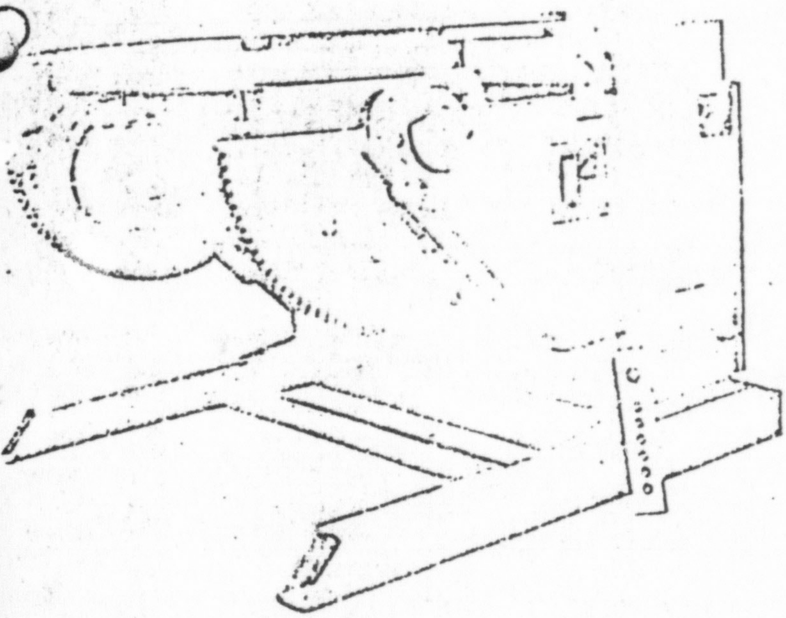
Number of Units: One

Manufacturer and Model: Ransome Company Model COF, or equal

HEAVY-DUTY PRECISION POSITIONER Model 60P

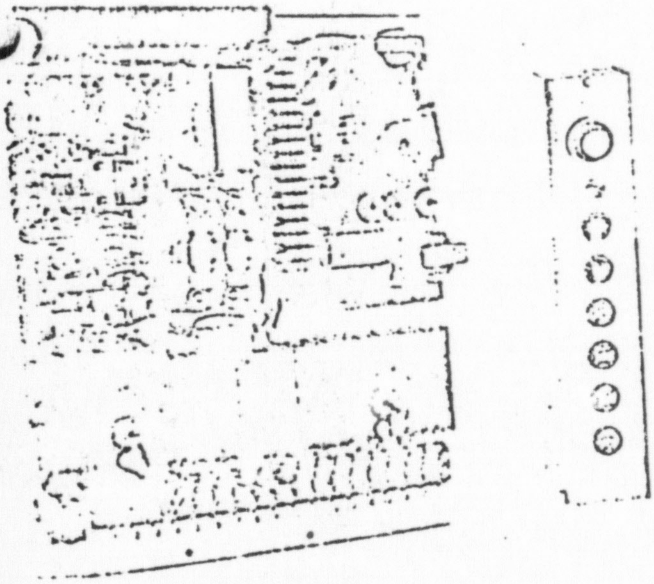
6,000-lb. capacity

12" eccentricity and 12" center of gravity



Rotation Drive

1. Rotation torque 72,000" lbs.
2. 3 H.P. — totally enclosed.
3. Electronic S.C.R. solid-state.
4. 40:1 ratio range.
5. Type A: Infinitely variable from .025 to 1.002 R.P.M.
   Type B: Constant speed table rotation at 1 R.P.M. powered by a 3 H.P. A.C. Brake Motor.
6. Reversible.
7. 2% speed regulation of set speed.
8. Constant torque at full to no load.
9. High-frequency protected.
10. Jam-proof switching.
11. Dynamic braking.
12. Rapid traverse control.
13. Remote control of all functions.
14. Pilot lamp.
15. Full-wave rectification.
16. Self-locking reducer.



Tilt Drive

1. Tilt torque 126,000" lbs.
2. 3 H.P. A.C. brake motor.
3. Extra large gears
4. Self-locking reducer.
5. Direct drive.
6. No chains or belts.
7. Table will not drift at rest.
8. Over-travel protection by adjustable limit switches.
9. 135° of travel.
10. Jam-proof switching.
11. Thermal overload protection.
12. Remote control of all functions.
13. Twin tilt segments.

Basic Features

1. 60" dia. table.
2. Machined face plate.
3. 6 radial "T" slots
4. Tilt protractor.
5. Minimum backlash.
6. Independent drives do not cross each other.
7. 18" of adjustable elevation.
8. Adjustable gear mesh.
9. Ground shoe.
10. 220 or 440 volt operation.
11. Hollow Spindle.

Ransome Company • Division of Big Three Industries, Inc.
Hamilton Blvd. at Interstate 287, So. Plainfield, N.J. 07[illegible] • (201) 75[illegible]

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

PIPE POSITIONER - B

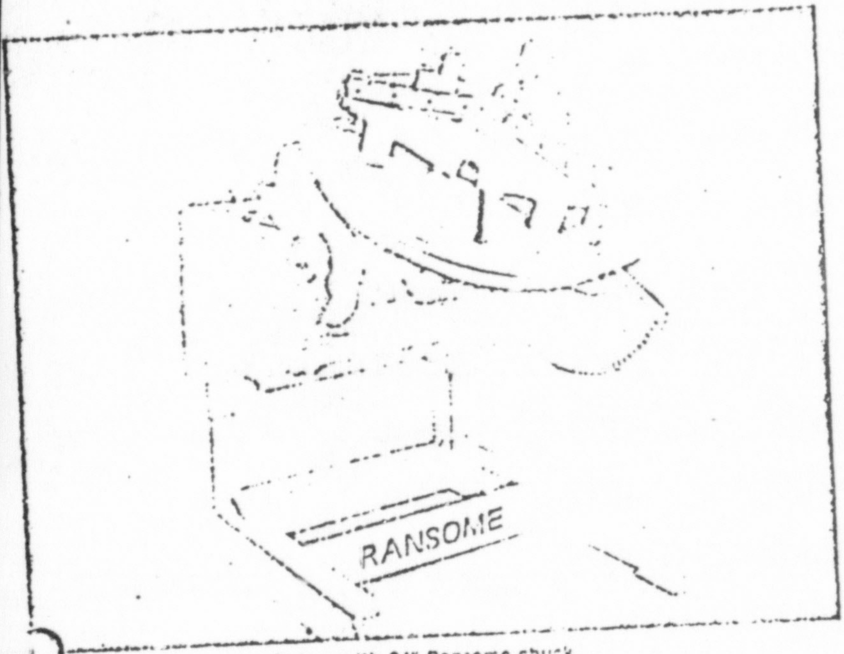
Number of Units: Two

Manufacturer and Model: Ransome Company Model 5P, or equal

(2)

RANSOME
HEAVY-DUTY PRECISION POSITIONER
Model 5P
500-lb. capacity

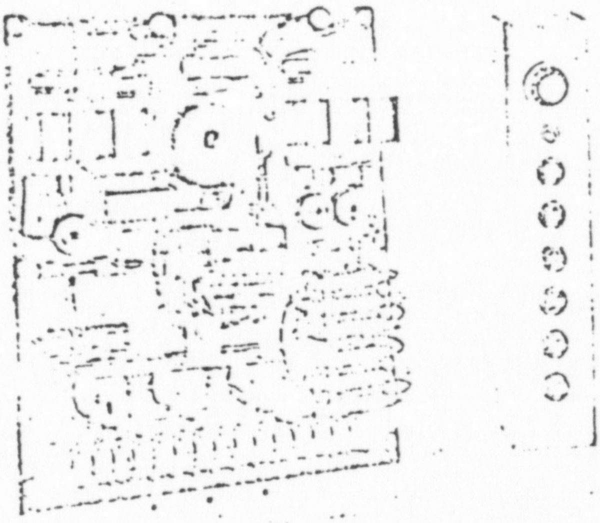
6" eccentricity and 6" center of gravity



Shown with 24" Ransome chuck

Rotation Drive

1. Rotation torque 3,000 inch pounds.
2. ¼ H.P. — totally enclosed.
3. Electronic S.C.R. solid-state.
4. 40:1 ratio range.
5. Type A: Infinitely variable from .05 to 2.0 R.P.M.
   Type B: Constant speed table rotation at 1 R.P.M. powered by a ¼ H.P. A.C. Brake Motor.
6. Reversible.
7. 2% speed regulation of set speed.
8. Constant torque at full to no load.
9. Hi[illegible] frequency protected.
10. Jam-proof switching.
11. Dynamic braking.
12. Rapid traverse control.
13. Remote control of all functions.
14. Pilot lamp.
15. Full-wave rectification.
16. Self-locking reducer.



Tilt Drive

1. Tilt torque 5,000 inch pounds.
2. ¼ H.P. A.C. brake motor.
3. Extra large gears.
4. Self-locking reducer.
5. Direct drive.
6. No chains or belts.
7. Table will not drift at rest.
8. Over-travel protection by adjustable limit switches.
9. 135° of travel.
10. Jam-proof switching.
11. Thermal overload protection.
12. Remote control of all functions.

Basic Features

1. 30" dia. table.
2. Machined face plate.
3. 4 radial "T" slots.
4. Tilt protract[illegible]
5. [illegible]
6. [illegible]
7. 18" of adjustable [illegible].
8. Adjustable [illegible].
9. Ground [illegible].
10. 220 or 110 volt [illegible].
11. Hollow Spindle.

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

ABRASIVE CUT OFF MACHINE

Number of Units: One

Manufacturer and Model: Wallace Supplies Mfg. Co., Series 3400 Abrasive Cut-Machining Unit, or equal

3400 SERIES WALLACE "CUT-MACHINING" UNIT

SPECIFICATIONS:

Wheel Size Diameter	16"
Motor	7-1/2 H.P.

CAPACITY:

Pipe, Standard Wall	4"
Tube	4" O.D. x 1/4" Wall
Angles	3" x 3" x 1/2"
Solid Rounds	2-1/4" Diameter
Solid Squares	2" Square
Channels	4" Standard

All motors are 220/440 volts - 3 phase - 60 cycle - or 550 volts - 3 phase - 60 cycle for Canadians. Any change in electrical characteristics will take an extra charge. Push button starter included on all machines.

The 3400 Series is truly a fine, flexible, fast, high quality production tool.

There are hundreds of the earlier 1700 Series Combination "Cut-Deburr" straight cut-off units with years of field proved service in use today.

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

COLD PIPE BENDING MACHINE

Number of Units: One

Manufacturer and Model: Wallace Supplies Mfg. Co., Model 603-180, semi-automatic, hydraulic, rotary type bender complete with mandrels, hydraulic mandrel extractor and dies, or equal

Maximum Radius Adjustment: 24"

Capacity: 3" IPS extra heavy

Bending Arm Rotation: 210 degrees

Mandrel Length: 12' - 6"

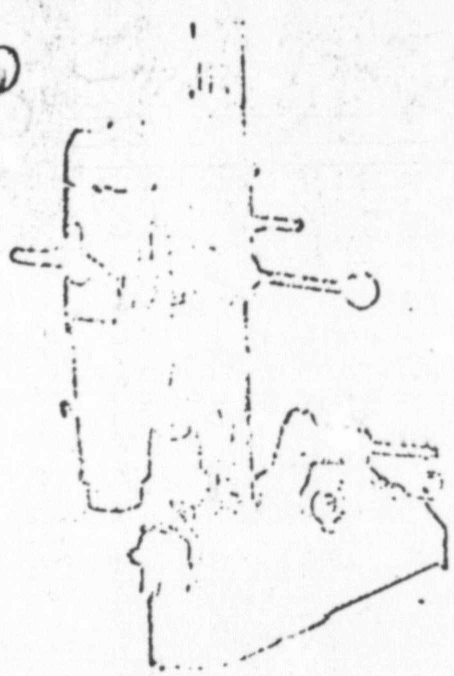
Drive Horsepower: 5

MAGNETIC DRILL PRESS

Number of Units: One

Manufacturer and Model: Black & Decker, Model 741 - $1\frac{1}{4}$"

Heavy Duty, Two-Speed, Magnetic Drill Press, or equal

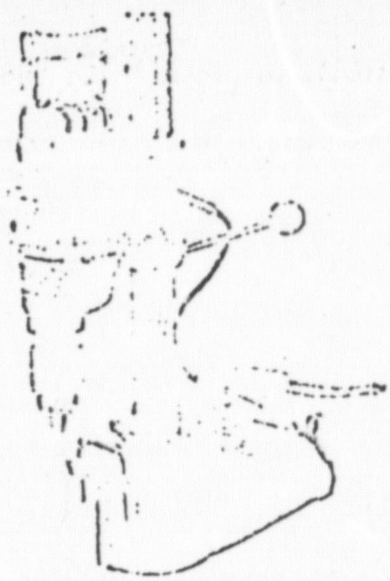


1-1/4" H.D. Two Speed Magnetic Drill Press
Model No. 741 250 & 500 R.P.M.

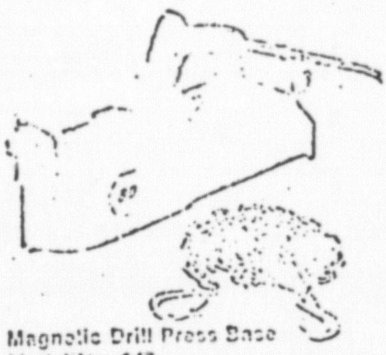
The 1¼" H.D. TWO-SPEED Magnetic Drill Press gives full power in both speeds—forward and reverse. A sliding gear shift knob changes no-load R.P.M. to either 250 or 500—even while motor is running. The two-speed feature makes possible a practical drilling speed for drilling holes from 1¼" down to ¾" with the included No. 3 Morse Taper Socket. This is particularly useful when drilling small pilot holes for large drill bits. Both sized holes can be drilled with one Drill and with the correct speed for both drill bits.
For drilling smaller holes, a Chuck mounted on a Morse Taper Arbor (see next page) can be used. See specifications below.

Drill Press Caddy
Model No. 39349

Provides light, easy transportation to any work location for either the ¾" or 1¼" Magnetic Drill Press.

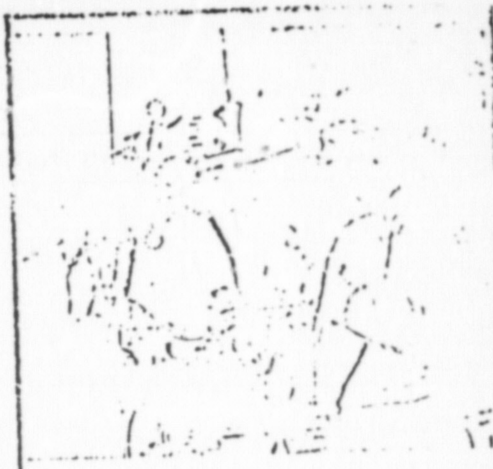


3/4" H.D. Magnetic Drill Press
Model No. 674 375 R.P.M.
Model No. 674-4 450 R.P.M.

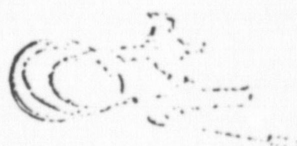


Magnetic Drill Press Base
Model No. 8[illegible]

Perfect for holding two pieces of ferrous metal together while welding. Also, handy for holding steel sheets together during fastening operations. Two handles permit easy handling. Eye bolts allow overhead suspension with chain if desired. Safety light indicates when Base is magnetized. 18¾" long, 4[illegible]" wide. Net wt. 55 lbs., Ship. wt. 57 lbs.



The accuracy of a stationary Drill Press and the versatility of a Portable Drill are built into these easily carried, 2-piece units. [illegible] the [illegible] Drill Press handles drilling [illegible] that are extremely difficult or [illegible] impossible with con[illegible] or stationary equipment. It [illegible] magnetically—[illegible] down [illegible] any angle on a [illegible] of ½" or more. [illegible] be used on lighter [illegible] drills by [illegible] conven[illegible] Power Feed [illegible] see below). [illegible] full power to the [illegible] rotation can be [illegible] power. Magnet [illegible] be used se[illegible] holding device for [illegible] fastening operations



Hydro-Power Feed [illegible]
Model No. [illegible] (for ¾" Mag. Press)
Model No. [illegible] (for 1¼" Mag. Press)

Permits operator to [illegible] of the drill while [illegible] as 6 ft. from Drill Press. Ship. wt. 9¾ lbs.

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

DRILL PRESS

Number of Units: One

Manufacturer and Model: Avey Drilling Machine Company,

Model 30 MA 6 upright, box column, gear drive, Drilling Machine, or equal

Spindles: Two

Swing: 24 inches

Horsepower: 5

BAND SAW

Number of Units: One

Manufacturer and Model: Racine Hydraulic & Machinery, Inc.,

Model 1010 power feed, hydraulic control, Band Saw, or equal

Capacity: 10" x 10" stock

Horsepower: 3

ENGINE LATHE

Number of Units: One

Manufacturer and Model: American Tool Works Company, Pacemaker Engine Lathe, or equal

Bed Length: 72 inches CC

Swing: 20 inches

Horsepower: 20

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

PNEUMATIC GRINDER

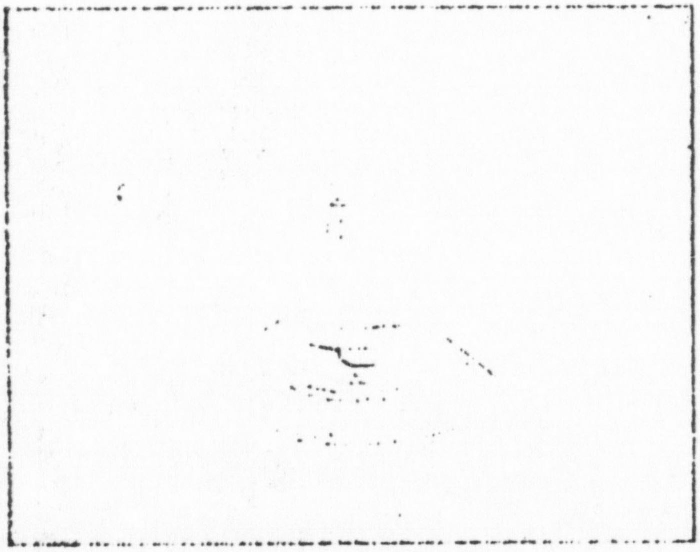
Number of Units: Six

Manufacturer and Model: Chicago Pneumatic Vertical Grinder

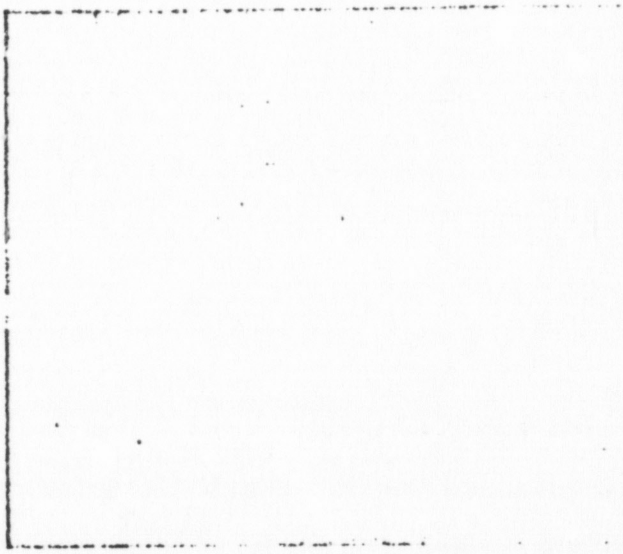
Model CP-3190 A 4500-P, or equal

CP-3190 VERTICAL GRINDERS AND SANDERS

- Tough plastic-coated housings—protects tool and prevents housing damage when tool is subjected to rough usage.
- Unique splined floating rotor—extends operational life and facilitates servicing. Protects motor from axial thrust loads—eliminates complex bearing and shim adjustments.
- Unitized motor design—enables removal of motor as an assembly.
- Teasing throttle—permits operation over the speed range—low speeds for fine sanding or buffing, or high speeds for fast grinding.
- Forged, hardened, ground and honed liner—resists wear, permits maximum power.



CP-3190-LA-7750-P Vertical Sander with 7" depressed center wheel and guard, lever throttle and plastic-coated housing.



SPECIFICATIONS—CP-3190 Vertical Grinders and Sanders

Type No.	CAPACITY (inches) Cup Wheel Organic Hard	Sanding Pad	Cup Wire Brush	*Cut-off Disc Wheel	Free Speed (RPM)	Spindle Thread	Height (inches)	Side to Center (inches)	Net Weight (pounds)	Air Inlet Thread Size (NPT)
CP-3190-A-7750-P	4	5	4	7	7750	5/8"—11 x 1[illegible]"	6[illegible]	1[illegible]	7	1/2
CP-3190-A-6000-P	6	7	4	9	6000	5/8"—11 x 1[illegible]"	6[illegible]	1[illegible]	7	1/2
CP-3190-A-4500-P	[illegible] 6	9	6	--	4500	5/8"—11 x 1[illegible]"	6[illegible]	1[illegible]	7	1/2

*Rating for Type 28—Depressed Center Wheel or Type 27—Dished Wheel.

STANDARD EQUIPMENT:

Plastic-coated housing for added wear resistance.
[illegible] cup wheel guard of rated capacity size.
C-[illegible] [illegible]
C-[illegible] Spacer for sanding pads.
"A" Manual release throttle—remains in wide open position, must be manually [illegible] to off position. (See page 112.)

EXTRA COST EQUIPMENT:

Ball bearing [illegible] shown in [illegible] on page [illegible].
Sanding pads, cup and depressed center wheels and wire brushes listed on pages 1[illegible], 124.

OPTIONAL EQUIPMENT:

(Furnished at no extra cost if specified.)
Housing without plastic coating. Delete "P" from Type No.
C-[illegible] with internal [illegible] thread for lock screw [illegible] in place of standard spindle.
C-[illegible] Adapter for holding [illegible] [illegible]
Any [illegible] in place of standard [illegible]
"LA" [illegible] lever throttle.
"SLA" [illegible]
"DA" Self-[illegible] throttle—must [illegible] automatically returns to off [illegible]
"SA" Shut-off throttle [illegible] lever throttle [illegible] is admitted to [illegible]
"TA" Adjustable [illegible] must be manually [illegible]
Any one [illegible] standard [illegible]
Sanding [illegible] standard [illegible]
C-[illegible]
CA [illegible]

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

SAND BLASTING MACHINE

Number of Units: One

Manufacturer and Model: Sanstorm Manufacturing Company, Model FSR 600 lb. capacity, stationary, remote-controlled Sandblast Machine, complete with air supplied positive pressure helmets and standard pipe sand blasting accessories, or equal.

MACHINE DATA

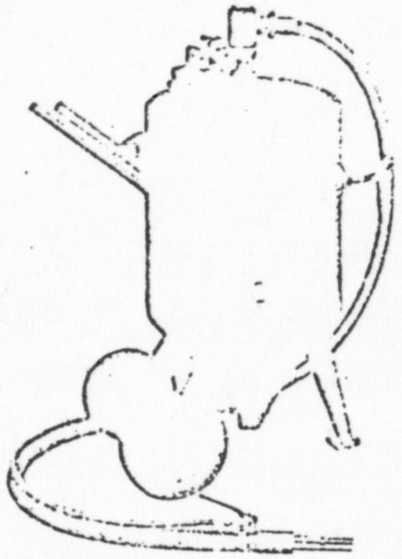
[illegible]

Model No.	[illegible]	[illegible]	[illegible]	Diameter	[illegible]	[illegible]
[illegible] (portable)	2	[illegible]	[illegible]	16"	[illegible]	[illegible]
ARW (portable)	[illegible]	[illegible]	[illegible]	16"	[illegible]	[illegible]
AR (stationary)	4	350#	875#	16"	[illegible]	[illegible]
*BRW (portable)	7	[illegible]	1625#	24"	[illegible]	[illegible]
BR (stationary)	7	[illegible]	[illegible]	24"	[illegible]	[illegible]
BRW-26 (portable)	7	[illegible]	1625#	24"	[illegible]	[illegible]
GPR (portable)	3	[illegible]	750#	16"	[illegible]	[illegible]
GSR (stationary)	3	300#	750#	16"	52"	[illegible]
*FPR (portable)	7	600#	1500#	24"	55"	[illegible]
*FPR-26 (portable)	7	600#	1500#	24"	55"	[illegible]
FSR (stationary)	7	600#	[illegible]	24"	[illegible]	[illegible]
[illegible] (portable)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*MSR (stationary)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

"Closed and Open Top"

REMOTE CONTROL (at nozzle) MODELS



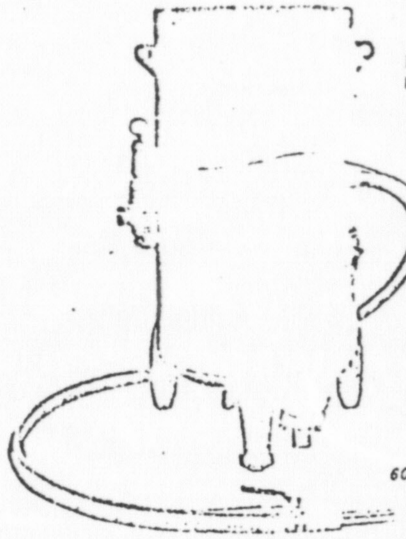
BRW (portable) "Closed Top"
Remote Control Model

Mounted on 12 x 3.00 zero pressure rubber tired wheels.

NOTE – Model BRW available with 18 x 400 pneumatic rubber tired wheels and "T" type draw bar as shown with Model FPR-25 on page 10; specify Model BRW-26.

650# Sand Capacity

For use with 25 HP or 125 CFM and larger air compressors.

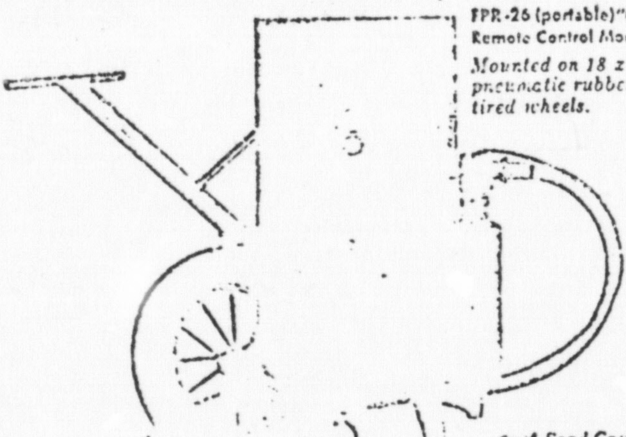


FPR (portable) "Open Top"
Remote Control Model

Mounted on 12 x 3.00 zero pressure rubber tired wheels with handle bar as shown by Model BRW hereo

600# Sand Capacity

For use with 25 HP or 125 CFM and larger air compressors.

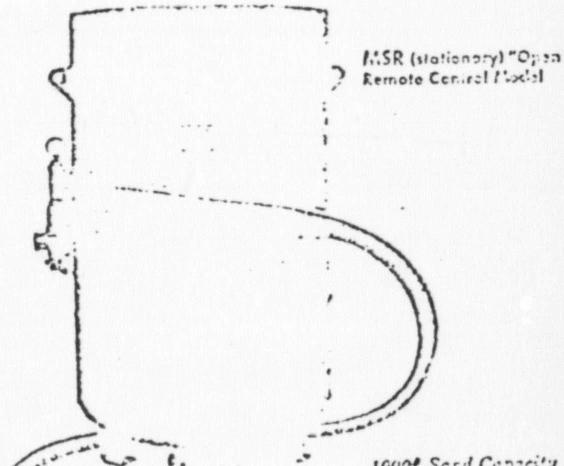


FPR-26 (portable) "Open Top"
Remote Control Model

Mounted on 18 x 4.00 pneumatic rubber tired wheels.

600# Sand Capacity

For use with 25 HP or 125 CFM and larger air compressors.



MSR (stationary) "Open To
Remote Control Model

1000# Sand Capacity

For use with 50 HP or 250 CFM and larger air compressors.

Machine data on above shown on page 11.

All manual control machine sizes and models as shown or listed on pages 8 and 9 are also available with remote control systems as shown above and listed on page 11 opposite – Models CW and HC as shown on page 8 are not available with remote control system.

All remote control models shown above and listed [illegible] are arranged with Sandstorm "TRC Remote Control Kit" as shown on pages 36 and 37 (RCAV-S [illegible] type Remote Control Actuator Valve [illegible] unless [illegible] RCAVR valve specified.)

Crippen Pipe Fabrication Corporation

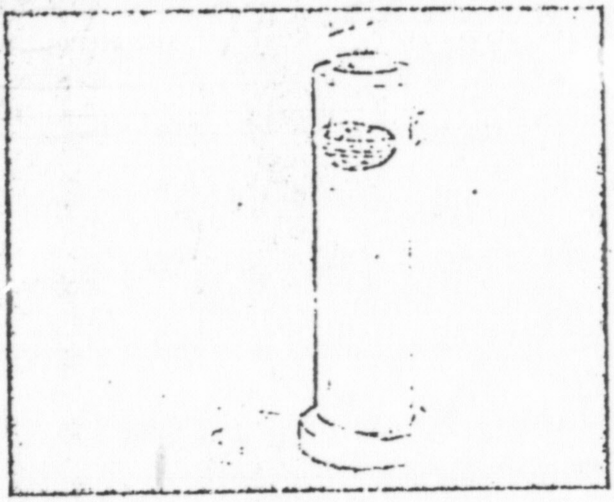
INDUSTRIAL PIPE BENDING AND FABRICATION

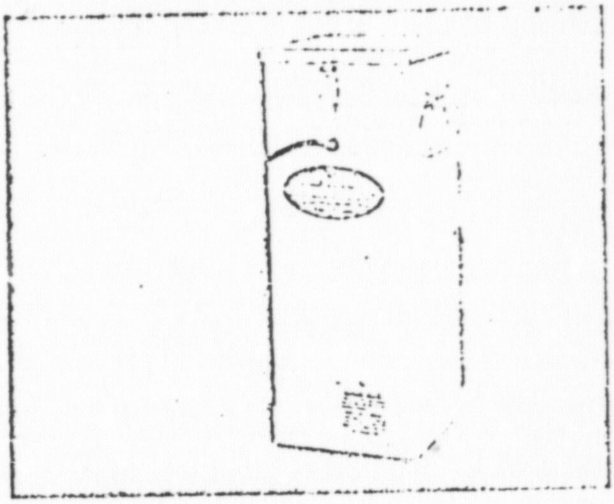
ELECTRODE OVEN

Number of Units: Four

Manufacturer and Model: Phoenix Model 10A, 100 watt, portable Electrode Oven, or equal

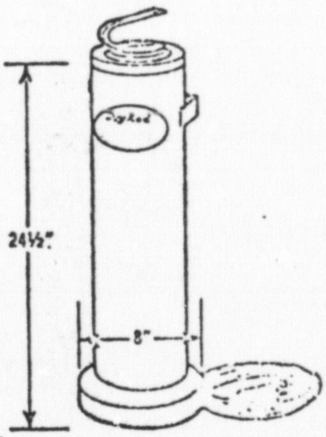
PORTABLE/OVENS



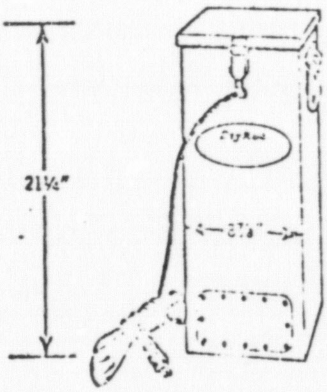


Here's portable protection in either of two units. They've been specifically designed for field or shop use . . . for welding profits. Both can be carried anywhere. Fully loaded, the Type 10A weighs only 23 lbs. The Type 50A, 79 lbs. Both offer 100% protection of electrodes up to 18" in length from unpacking to actual use. Both stand firm either vertically or horizontally, and can plug into any 110-120 volt outlet. They both give even, continuous heat to keep rods fresh and dry. The Type 50A seals air tight for "round-the-clock" protection . . . even after disconnection from power source. They're rugged units of all welded steel construction, attractively and durably finished in high visibility yellow and red. They automatically maintain correct stabilizing temperatures; no tampering with thermostats by unauthorized personnel.

TYPE
10A



TYPE
50A



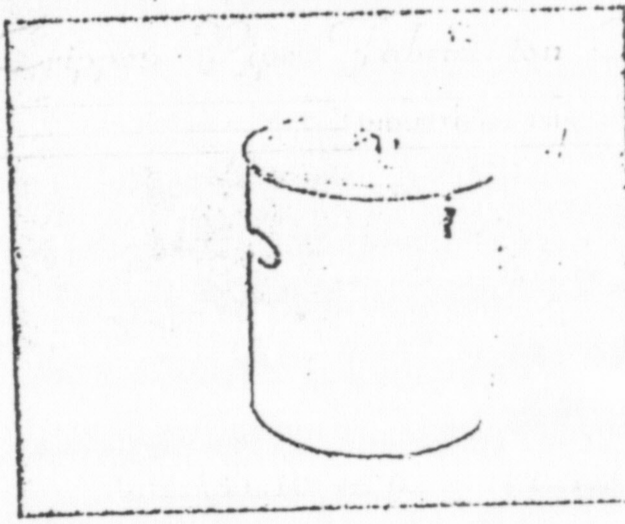
SPECIFICATIONS	TYPE 10A Catalog No. [illegible]	TYPE 50A Catalog No. [illegible]
Electrode Capacity	13 lbs. 18" electrode	50 lbs. 18" [illegible]
Size Electrode Handled	10", 12", 14", 18"	10", 12", 14", 18"
Sheathed Heating Element (1)	100 Watts	200 Watts
Voltage	115 Volts AC-DC (Single Phase)	120 Volts AC-DC [illegible]
Grounded Heavy Duty Cord (permanently attached)	10' three wire cord with grounding cap.	10' three wire cord with grounding cap.
Temperature Range	275°F Average [illegible]	[illegible]
Thermostat	None — Constant [illegible]	[illegible]
Insulation	1" Mineral [illegible]	[illegible]
[illegible]	3½" [illegible]	[illegible]
Exterior Dimensions	8" dia. x 24½"	[illegible]
Net Weight	15 lbs.	[illegible]
Shipping Weight & Dimensions in Carton	19 lbs. — [illegible] x 10" x [illegible]	[illegible]

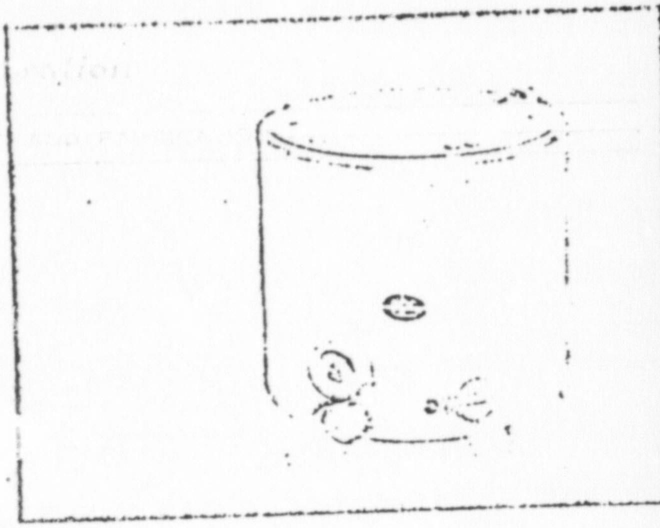
FLUX - HOLDING OVEN

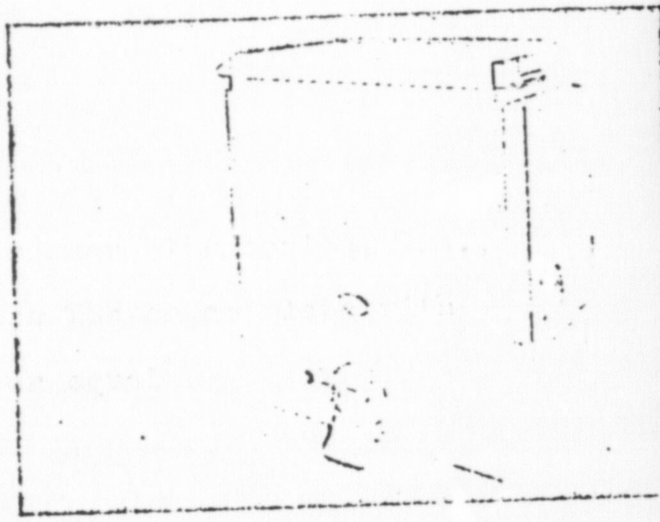
Number of Units: One

Manufacturer and Model: Phoenix, Model 100FX, 1000 watt, portable Flux-holding Oven, or equal

FLUX-HOLDING/OVENS







Another Phoenix DryRod first — 3 new flux holding ovens. Designed for quantity users of bagged welding flux, these ovens offer secure moisture proof storage of flux, from bag to use. Top load feature allows easy dumping of flux bags into oven for holding — or rebaking (750HT only).

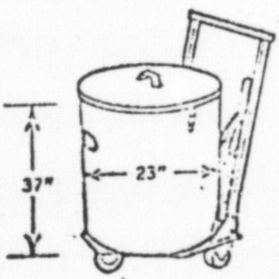
Types 950FX and 750HT have complete thermostatic control from 100°F to 450°F (950FX) and 800°F (750HT).

Both the above types have sloping bottoms for gravity flow dispensing through gate valves at the base.

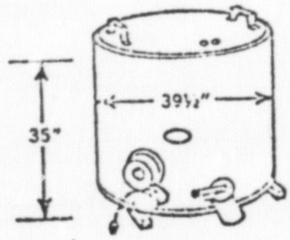
Type 750HT has stainless steel tubes interspersed through the heat chamber combined with bottom contact heaters to accommodate higher heat input and to offer faster and hotter warm up of contents.

Type 100FX, newest of the trio, has a sealed pre-set thermostat giving an average stabilized temperature of 240°F. It is small, weatherproof and mounted on a wheeled dolly for portability in shop or shipyard. Flux is held in canisters or pails which, when removed, offer space for (3) 60# flux cored wire rolls in the oven chamber. Detailed specifications listed below.

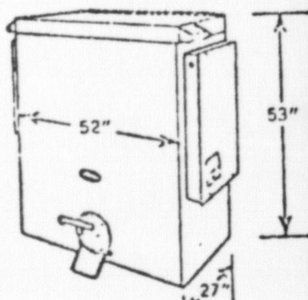
TYPE 100FX
Low Temperature



TYPE 950FX
Medium Temperature



TYPE 750HT
High Temperature



SPECIFICATIONS	TYPE 100FX Catalog No. 1201[illegible]	TYPE 950FX Catalog No. 120[illegible]	TYPE 750HT (High Temperature) Catalog No. 12[illegible]
Flux Capacity	100 lbs. [illegible] or 50 lbs. [illegible] or [illegible]	500 lbs. granulated flux	750 lbs. granulated flux
Heating Elements	[illegible]	3.0 KW [illegible]	6.0 KW [illegible]
Voltage	120 volts, AC, single phase	240 or 480 volts (specify one) 50 or 60 cycles A.C. single phase	240 or 480 volts (specify one) 50 or 60 cycles A.C. three phase
			Terminal box [illegible] wiring
Input Connection	10 ft. [illegible] [illegible]	[illegible] [illegible]	[illegible]
Temperature Range	[illegible]	[illegible]	[illegible]
Thermostat	[illegible]	Double Pole [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

ULTRASONIC THICKNESS TESTER

Number of Units: One

Manufacturer and Model: Krautkraemer Ultrasonics, Inc., Model K Ultrasonic Thickness Tester complete with Model KKR and KKS probes, or equal

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

MISCELLANEOUS EQUIPMENT

Magnaflux Spotcheck Type SK-3 Test Kits

Hydrostatic Test Rig with Water Demineralising Unit

Pneumatic Sand Packing Hammers

Gas Preheating Torches

Quench Tank - Epoxy-lined, 32' x 5' x 8'

Surveyors Transit

Micrometers, Calipers and Gages

Chipping Guns

Chain Jacks and Bar Clamps

Tool Room Dehumidifier

Industrial Vacuum Cleaner

Pipe Rollers

Bench Grinders

Tempilstiks

Hand Tools and Measurement Equipment

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

BRIDGE CRANE

Number of Units: One

Manufacturer and Model: Dresser "Shaw-Box", 3-motor, double girder, floor controlled, Class D, Electic Overhead Travelling Crane, or equal

Capacity: 15 tons

Span: 92' - 0"

Lift: 44 feet

Hoist Speed: 20 FPM max.

Trolley Speed: 125 FPM max.

Bridge Speed: 175 FPM max.

JIB CRANE - A

Number of Units: Two

Manufacturer & Model: Dresser Model WBT Jib Crane, or equal

Capacity: 10,000 lbs.

Reach: 35 feet

Hoist: Load Lifter Series 700 Electric Hoist with motor driven trolley, or equal

Location: Hot Bending Area

JIB CRANE - B

Number of Units: Four

Manufacturer and Model: Dresser Model WET Jib Crane, or equal

Capacity: 4,000 lbs.

Reach: 30 feet

Hoist: Budget Electric Hoist with push type trolley, or equal

Location: Pipe Fitting and Welding Area

JIB CRANE - C

Number of Units: Four

Manufacturer and Model: Dresser Model [illegible]T Jib Crane, or equal

Capacity: 6,000 lbs.

Reach: 24 feet

Hoist: Load Lifter Series 7[illegible]0 Electric Hoist with motor-driven trolley, or Budget Electric Hoist with push-type trolley, or equal

Location: 3 - Pipe Fitting and Welding Area

1 - Sand Packing Area

INDUSTRIAL TRUCK CRANE

Number of Units: One

Manufacturer and Model: Silent Hoist & Crane Company, Inc., Krane Kar Model AY

Capacity: 10 tons

Accessories: Hydraulic jacks

Pintle type draw bar hook for pulling freight cars

FRONT-WHEEL DRIVE TRACTION WHEELS support Chassis and Crane Load.

CAB AXLE of forged alloy steel, straddles both chassis rails.

A[illegible] SWING LIMIT STOPS force into n[illegible] the Winches for Boom Swinging [illegible] Boom Topping. Engine is not stalled to accomplish these important Safety Features.

2-GEARED SPEEDS for Hoisting, Swinging, and Topping, in addition to availability from idling to engine-governed speeds. (Mechanical models.)

NO TAIL-SWING and no part of Crane (stationary or moving) passes over Operator's head.

ENTIRE LENGTH OF BOOM EFFECTIVE FOR REACH . . . Boom Hinge located at Front of truck.

CRANE MAST SUPPORTS MACHINED WITH MATCHING STEPS EDGES, taking full shear load of Crane. Not dependent on bolts in tension.

CAPAC Capac	
BOOM (On	
SPEED	
ENGI	

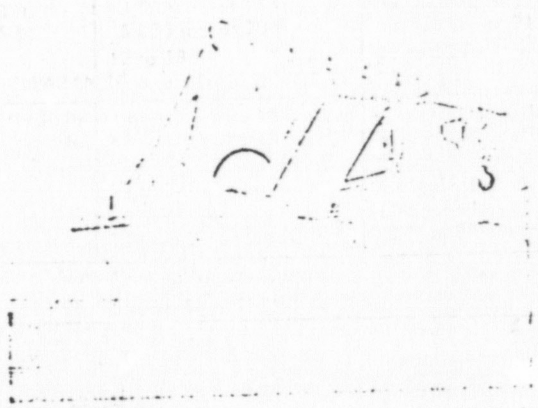


FIG. 4 RAIL-O-ROAD CRANE [illegible]. Equipped with both Rubber Tires and RR Flanged Wheels. (Also available with Railroad Wheels only.)

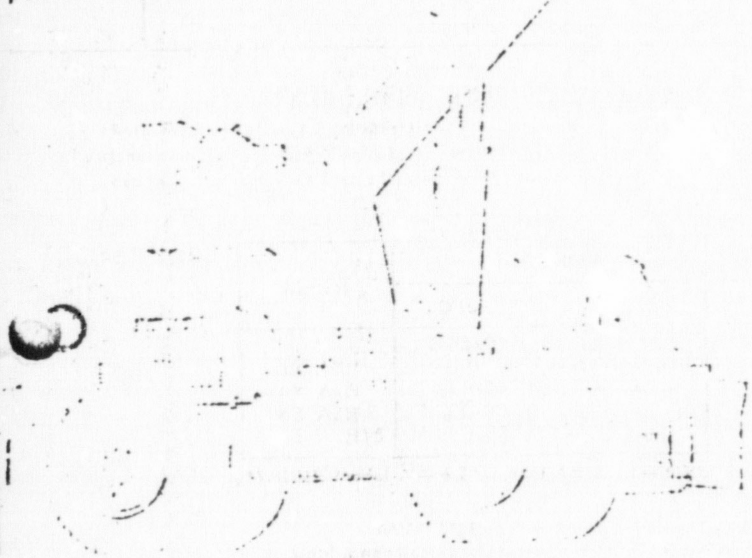
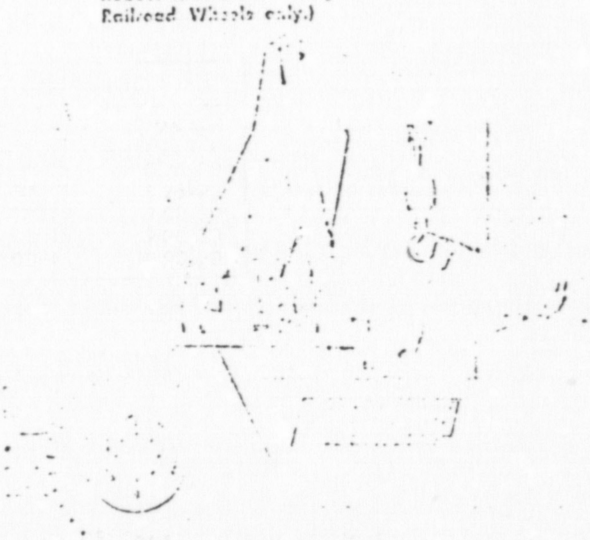


FIG. 3 Above—MODEL CAZ. Ask for Bul. 299.



"WHOW-HOW"

Since 1910, SILENT HOIST has led in the [illegible] [illegible] Equipment . . . [illegible] [illegible] Cranes [illegible] [illegible] Crane [illegible] SILENT HOIST [illegible]

CONDENSED SPECIFICATIONS

ALL SPECIFICATIONS AND DATA SUBJECT TO CHANGE WITHOUT NOTICE

...NS	Model A	Models AX/AXH	Models AY/AYH	Models AZ/AZH	Models AZ15/AZH15
...s ....hart, Page 5	5,000 lbs. at 5 ft. 3,600 lbs. at 7 ft. 2,500 lbs. at 10 ft. 1,550 lbs. at 15 ft.	10,000 lbs. at 5 ft. 7,000 lbs. at 7 ft. 5,000 lbs. at 10 ft. 3,200 lbs. at 15 ft.	20,000 lbs. at 4 ft. 6 in. 12,000 lbs. at 7 ft. 8,400 lbs. at 10 ft. 5,600 lbs. at 15 ft.	25,000 lbs. at 5 ft. 6 in. 13,000 lbs. at 10 ft. 8,500 lbs. at 15 ft. 5,000 lbs. at 20 ft.	30,000 lbs. at 6 ft. 20,000 lbs. at 8 ft. 7 in. 12,500 lbs. at 13 ft. 4 in. 7,500 lbs. at 21 ft.
....	12 to 18 ft.	12 to 13 ft.	12 to 18 ft.	12 to 18 ft.	12 to 18 ft.
...vailable)	For CAPACITIES FOR LONGER BOOMS, see HOOK CLEARANCE and LOAD CHARTS on Page 5.				
...rd	4 speeds 2¼ to 15 mi./hr.	4 speeds 2 to 12 mi./hr.	4 speeds 1½ to 10 mi./hr.	4 speeds 1½ to 10 mi./hr.	4 speeds 1½ to 10 mi./hr.
...e	4 speeds 2¼ to 15 mi./hr.	4 speeds 2 to 12 mi./hr.	4 speeds 1½ to 10 mi./hr.	4 speeds 1½ to 10 mi./hr.	4 speeds 1½ to 10 mi./hr.
....	2 speeds up and down 50 to 80 ft./min.	2 speeds up and down 35 to 55 ft./min.	2 speeds up and down 25 to 45 ft./min.	2 speeds up and down 19 to 34 ft./min.	2 speeds up and down 19 to 34 ft./min.
...o Max. Vertical	10 Seconds 180° in 15 Seconds	13 Seconds 180° in 20 Seconds	25 Seconds 180° in 25 Seconds	30 Seconds 180° in 30 Seconds	30 Seconds 180° in 30 Seconds
...ON	Available with Gasoline, LPG or Diesel engine . . . with Automotive Dry Clutch, Fluid Coupling, Torque Converter, Mechanical or Powershift Transmission.				

FAIL-SAFE — POSITIVE LOAD CONTROL

Both mechanical and hydraulic KRANE KARs feature self-locking worm-geared drives on Load Line and Boom Swing Control . . . resulting in smooth load positioning and positive *holding* action . . . even with loss of power or hydraulic failure.

TIRES

Model	TRACTION		STEERING	
	Dual	Single	Caster	Wide
A	8.25x20	12.00x20*	7.50x15	8.25x20
AX/AXH	9.00x20	14.00x20*	7.50x15	8.25x20
AY/AYH	14.00x20	—	9.00x15	9.00x20
AZ/AZH	14.00x20	—	9.00x15	9.00x20
AZ15/AZH15	14.00x20	—	9.00x15	10.00x20

*WIDTH: Model A — 6'2". Model AX/AXH — 6'3".

AVAILABLE: Extra Large Rubber Cushion Tires for applications demanding compact, highly maneuverable chassis.

Model	Tir...
A	soli...
A	pneum...
AX/AXH	soli...
AX/AXH	pneum...
AY/AYH	soli...
AY/AYH	pneum...
AZ/AZH	soli...
AZ/AZH	pneum...
*AZ15/AZH15	pn...

*AZH15 D... ...on H...

B is the Wheelbase...

B₁ Land TR are to... only, when Auxili...

C is Height only wh... is provided,

G is Tire Ground C...

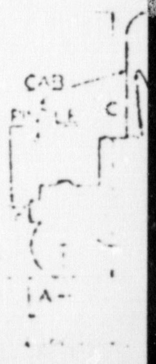
Dimensions ... vary with p...

KRANE KAR picks up a load of any shape or size up to 15 Tons . . . transports it . . . and spots it where desired, accurately, smoothly, safely. One engine powers the machine for Travel and for all Crane operations. One man in his comfortable self-adjusting seat has all Controls within arm's reach. Load Line Hoisting, Boom Topping and Boom Swinging (all by Power and with full load suspended from the hook) may be performed INDEPENDENTLY or SIMULTANEOUSLY — in the SAME or OPPOSITE directions — all at the will of the Operator on mechanical models.

FIG. 7

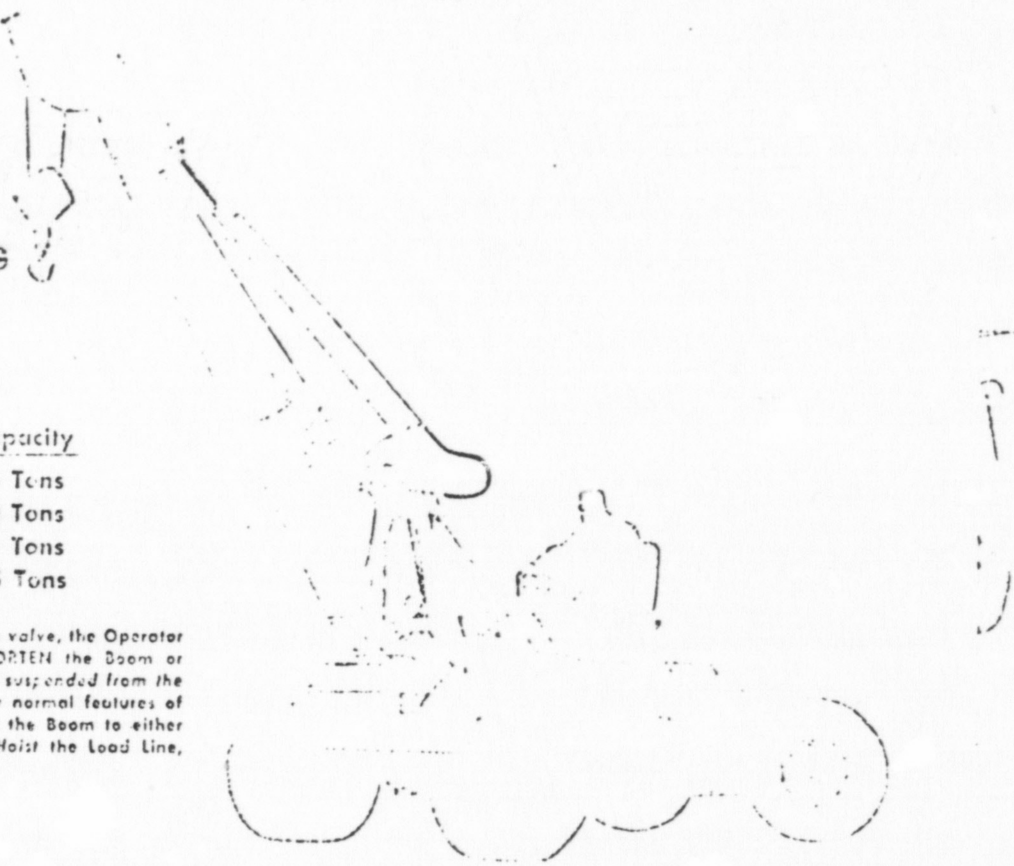
FIG 8

"HAMMERHEAD" INDUSTRIAL TRUCK CRANE
BOOM ENTERS VAN TRUCKS OR RR BOX CARS WITH EASE
ASK FOR BULLETIN 102



ALL HYDRAULIC

[illegible]
FLUID DRIVE
BOOM SWINGING
BOOM TOPPING
BOOM TELESCOPING
LOAD HOISTING
POWER STEERING



Model	Capacity
AXH	5 Tons
AYH	10 Tons
AZH	12½ Tons
AZH15	15 Tons

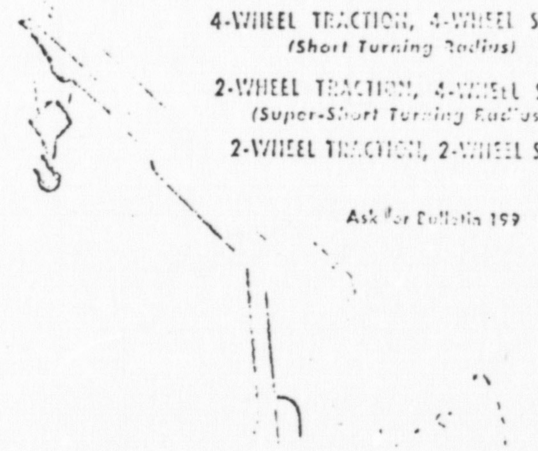
FIG. 9 — *Now, by a mere touch of a valve, the Operator may easily, smoothly, quickly,* SHORTEN the Boom or LENGTHEN the Boom *(with full load suspended from the hook)* in combination with the other normal features of the versatile KRANE KAR . . . Swing the Boom to either Right or Left, *Top* the Boom, and *Hoist* the Load Line, ALL BY HYDRAULIC POWER.

4-WHEEL TRACTION, 4-WHEEL STEER
(Short Turning Radius)

2-WHEEL TRACTION, 4-WHEEL STEER
(Super-Short Turning Radius)

2-WHEEL TRACTION, 2-WHEEL STEER

Ask for Bulletin 199



DIMENSIONS and WEIGHTS

C	D	E	G	H	K	L	M	P	T	TR	U	W	WT
8' 7"	20"	3'4"	104"	6'11"	33"	11'1"	10,400	3' 6"	5'6"	14'0"	9' 4"	5,000	15,000
5'11"	24"	3'0"	224"	7' 3"	33"	12'0"	10,400	3'10"	7'2"	14'8"	10' 5"	5,000	14,600
8' 8"	20"	3'4"	132"	7' 9"	32"	12'8"	15,000	3' 5"	6'2"	16'8"	10' 9"	10,000	21,000
9' 0"	25"	2'9"	374"	8' 0"	32"	13'8"	15,000	3'10"	7'11"	17'0"	11' 9"	10,000	20,000
8' 7"	21"	2'8"	704"	8'10"	35"	14' 7"	20,000	3' 6"	7'6"	19'0"	12' 9"	20,000	33,500
9' 4"	27"	2'2"	350"	9' 6"	35"	15' 9"	20,000	4' 3"	9'4"	20'0"	13'10"	20,000	31,500
8' 7"	23"	3'7"	204"	10' 0"	33"	17' 1"	25,500	3'10"	7'6"	22'5"	14' 5"	25,000	33,000
9' 5"	29"	3'2"	410"	10' 9"	33"	17' 7"	25,500	4' 7"	9'4"	21'6"	16' 5"	25,000	38,000
9'11"	33"	3'6"	440"	12' 2"	64"	19' 2"	26,500	4'10"	9'4"	23'0"	17' 0"	30,000	42,000

5 is 12'2".

... 5" for Models R and AT
... for Traveling is provided.
... or Overhead Guard
... mension H.
...nes.

H is to be increased by 9" for Model AXH . . . and by 8" for Models R and AT when Boom provided is longer than 20 ft.
P is Weight on Traction Wheels in Lbs.
U is Width of Intersecting Aisles.
W is Maximum Rated Capacity in Lbs.
WT is Weight of Krane Kar.

...ls depend on and will ...mponents selected.

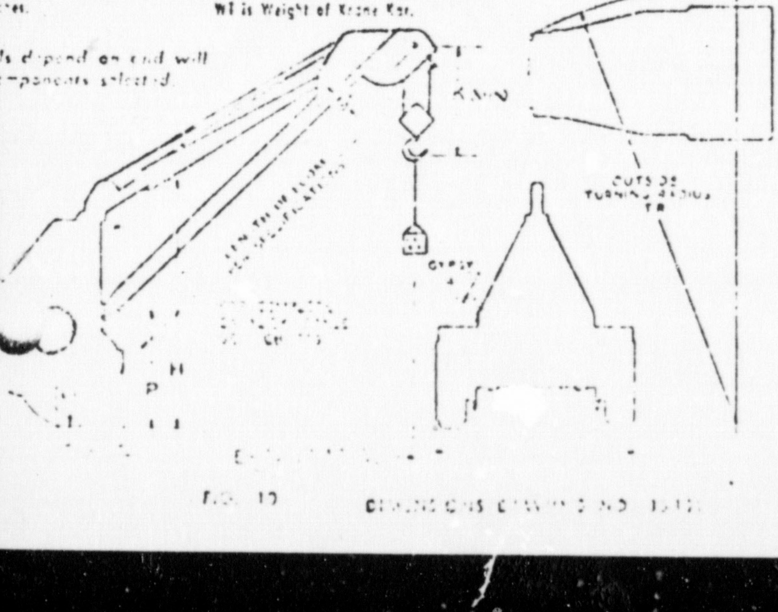
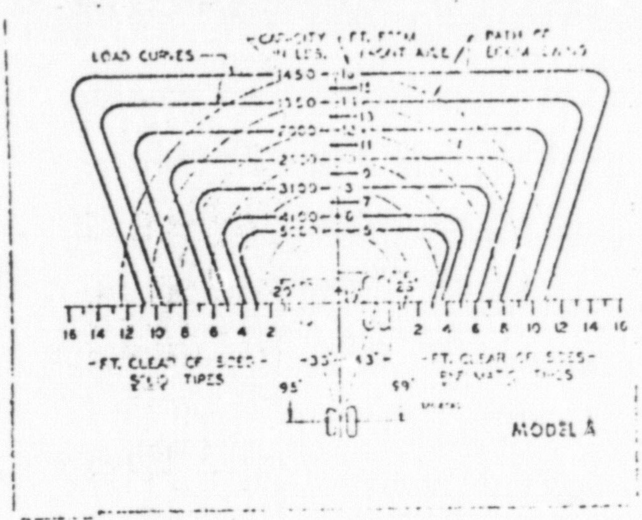
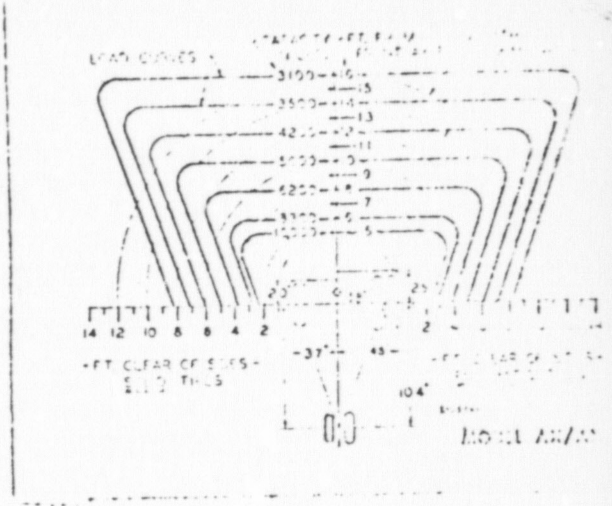
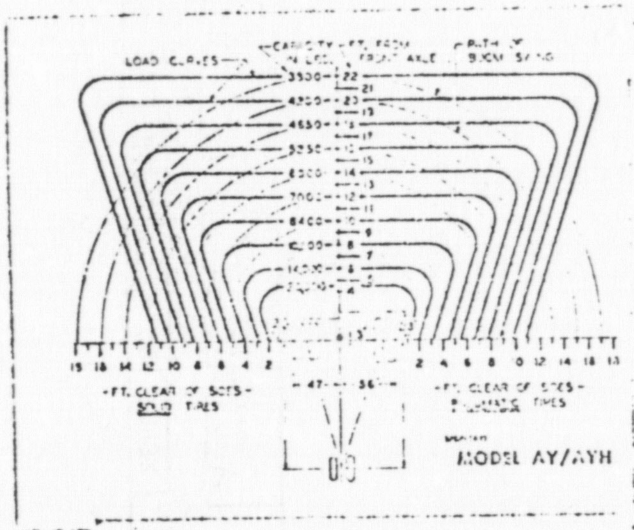
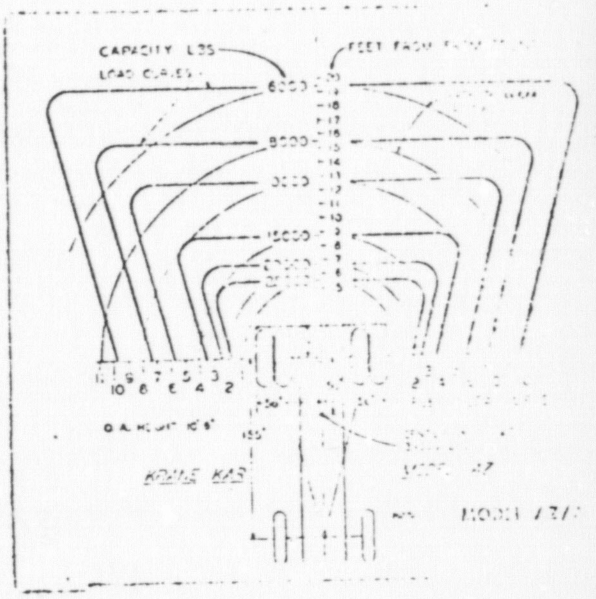


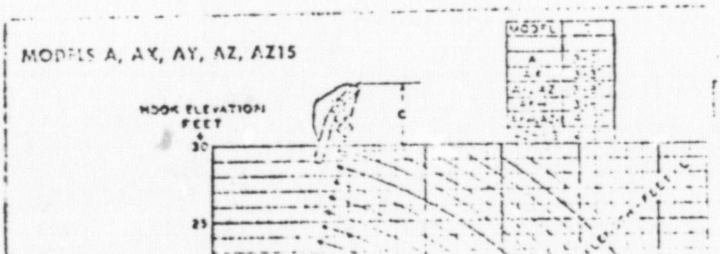
FIG. 10 DIMENSIONS DRAWING AND TABLE

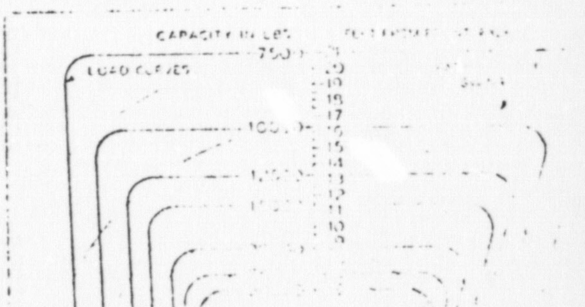

LOAD CURVES
CAPACITY IN LBS.
FT. FROM FRONT AXLE
PATH OF BOOM SWING
FT. CLEAR OF SIDES SOLID TIRES
FT. CLEAR OF SIDES PNEUMATIC TIRES
MODEL A

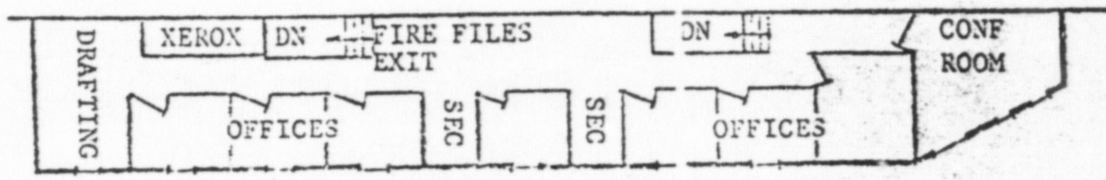

LOAD CURVES


LOAD CURVES
CAPACITY IN LBS.
FT. FROM FRONT AXLE
PATH OF BOOM SWING
FT. CLEAR OF SIDES SOLID TIRES
FT. CLEAR OF SIDES PNEUMATIC TIRES
MODEL AY/AYH


CAPACITY LBS
LOAD CURVES

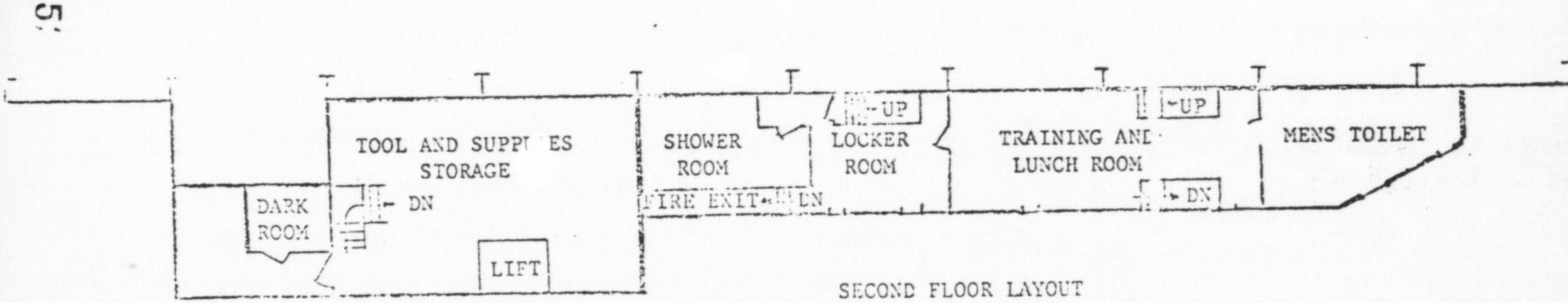

MODELS A, AX, AY, AZ, AZ15
HOOK ELEVATION FEET


CAPACITY IN LBS
LOAD CURVES



THIRD FLOOR LAYOUT

SCALE: ONE INCH EQUALS 25 FEET



SECOND FLOOR LAYOUT

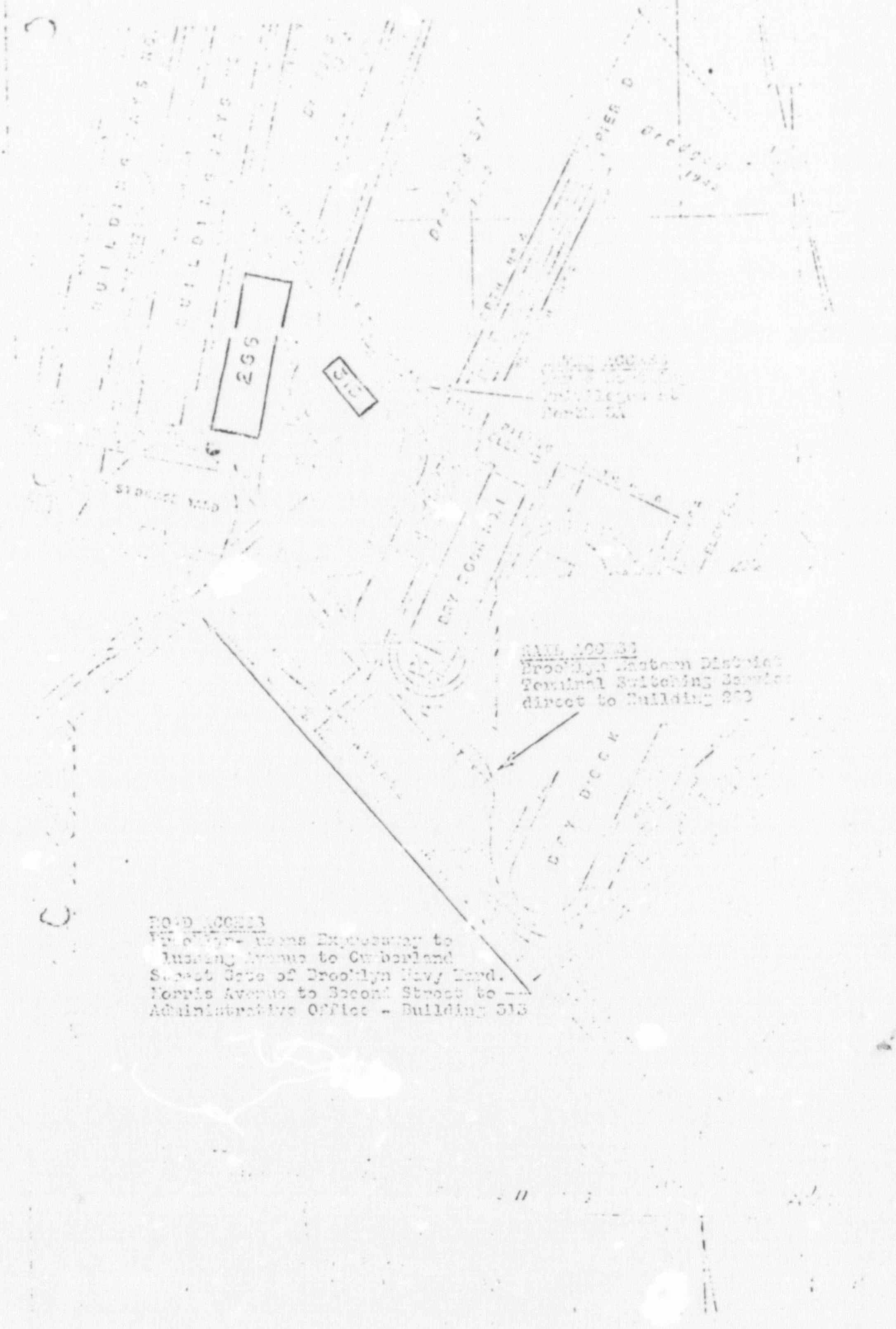
SECOND & THIRD FLOOR LAYOUTS - BUILDING 269

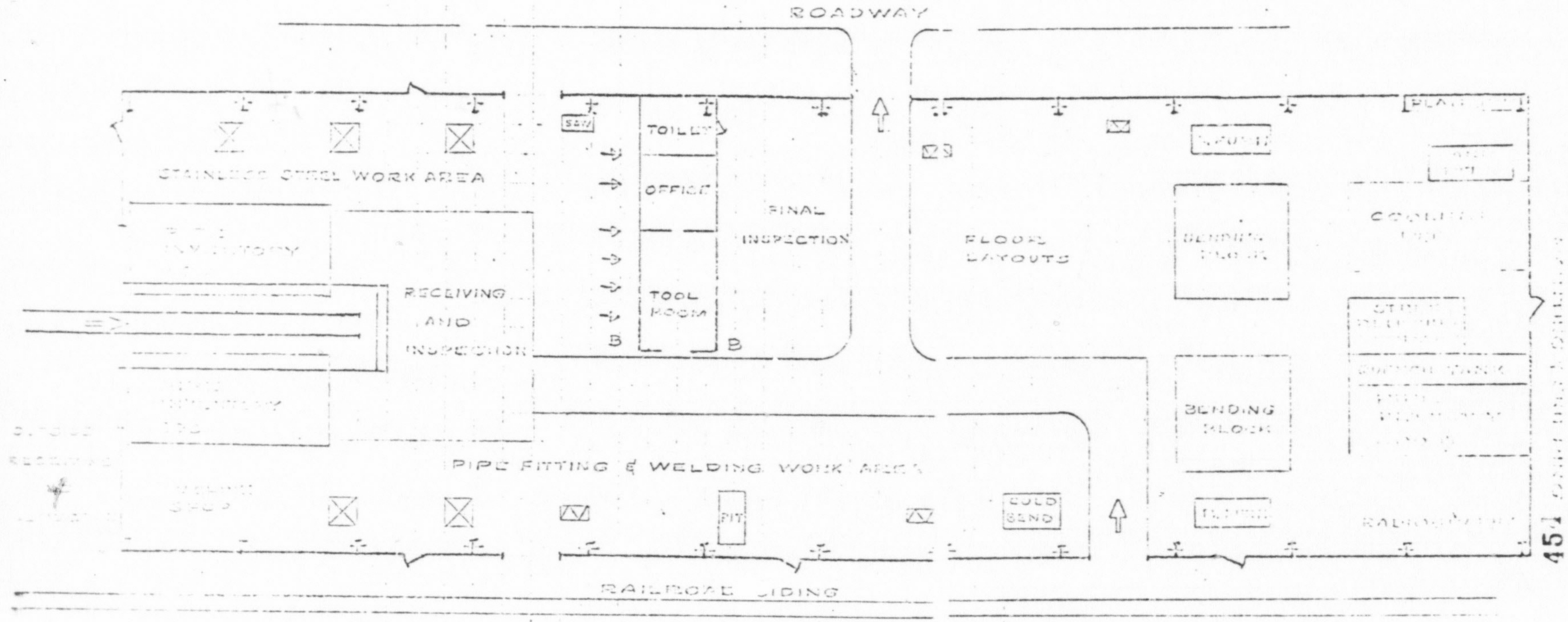
CRIPPEN PIPE FABRICATION CORPORATION

BROOKLYN NAVY YARD, BROOKLYN, NEW YORK

Brooklyn Navy Yard, Brooklyn, New York

Administrative Office - Building [illegible]
Manufacturing - Building [illegible]





SCALE: □ = 6'-2" SQUARE

OUTSIDE STORAGE
7000 sf

KEY
PIPEFITTING WORK TABLE
PIPE ROTATOR
JIB CRANE MOUNTED ON BUILDING COLUMN
BEVELING MACHINE
[illegible] EQUIPMENT

PLANT LAYOUT
BUILDING 268
BROOKLYN NAVY YARD

CRIPPEN PIPE FABRICATION CORPORATION

451

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

ryx-n

7-5-73

POST OFFICE BOX 217
MORRISANIA STATION
NEW YORK, N. Y. 10456

November 3, 1971

Dear

At the suggestion of I am writing this letter to you to acquaint you with the Crippen Pipe Fabrication Corporation. With extensive requirements for power piping, we believe that our company can provide an important service to you.

To more economically meet the needs of companies like for quality power piping, I developed and patented a new apparatus and method for hot pipe bending. As you can see from the section beginning on page 20 of the enclosed Confidential Report, this system offers many advantages over current industry practice.

In addition to our hot pipe bending, we will have a complete fabrication shop equipped to handle the full range of power piping fabrication operations. I have assembled a team of highly-skilled people, many of whom have worked with me in the past, and we have a lease commitment on an excellent facility at the Brooklyn Navy Yard. We expect to be in production next March.

Prior to the start of production, we must secure advance sales commitments covering our initial production. We are hopeful that will be willing to assist us in this endeavor.

Copies of our Confidential Report and our Equipment Manual which describe our overall business plan, organization and fabrication facilities, are enclosed. After you have had an opportunity to review this material, we would like to meet with you and other members of your organization. We have a scale model of the Hot [illegible]e Bending Apparatus which allows u[illegible] to give an in-depth presentation of hot pipe bending and show [illegible] numerous butt welds can be eliminated. We also have a scale mo[illegible] of our plant layout at the

Crippen Pipe Fabrication Corporation

INDUSTRIAL PIPE BENDING AND FABRICATION

POST OFFICE BOX 217
MORRISANIA STATION
NEW YORK. N. Y. 10456

Brooklyn Navy Yard. Having visited a number of pipe fabricating plants to evaluate their procedures, I have slide pictures which show the various industry practices. This presentation will enable you and your technical people to evaluate the Crippen process and see what our company has to offer.

If you have any questions you may telephone me at our temporary headquarters in the offices of the Interracial Council for Business Opportunity, (212) 889-0880, or at my home telephone, (212) 991-1940.

I look forward to meeting you in the near future.

Yours truly,

Henry O. Crippen

Henry O. Crippen

cc.

HOC:b Encls.

601 East 167th Street,
Bronx, New York 10456

Mr. Allen B. Wesler - President
Tubeco Inc.
123 Varick Ave., Brooklyn, N.Y.

March 6, 1968

Subject: Hot Pipe Bending Apparatus & Method

Dear Mr. Wesler:

In regards to our telephone conversation a couple of weeks ago I thought I should first write out my claims and give you a little better picture of the overall proposal. I have designed an apparatus and developed a unique method for simplified hot pipe bending. I have filed a patent application for this apparatus (called "C.R.E.D.I.T") which forms compound and circular pipe bends more rapidly, reduces butt welding and other secondary operations, while affording precision accuracy of any angle. C.R.E.D.I.T. enables the bender to form 3, 4, and 5-bend compounds in a single pipe without a butt weld.

To illustrate, I enclose three prints: Print marked "1" is the print of a six-bend compound; print number "2" is a five-bend compound, and print number "3" is a four-bend compound. These are only a few of the various combinations that can be formed. Having knowledge of your present methods of hot bending, I feel that I can safely state, that by the use of my development a minimum savings of 50% of your present labor costs for bent pipe fabrication can be realized. To further stress the economy of the development - it provides for bends up to 90-degree angles to be formed in 12" diameter pipe (including overhead expenses) at a cost of approximately $11.00 per bend. And a proportional cost for other pipe sizes.

These savings can be accomplished by: (a) a reduction in bending costs; (b) an increase in productivity, (c) by quality bends, which eliminates correction (RE-WORKING) of the bends, and (d) the reduction of butt welds, etc. C.R.E.D.I.T. provides for the bends to be formed into (right and left) compound pieces, which eliminates the costs of fabricating operations, such as: Lay-out work; beveling & boring; fitting, welding the joints; radiographic inspection; stress relieving, and multi handling, etc., etc. For example, just by eliminating two (2) butt welds in 12" pipe X 2.250" wall, saves upwards of $400.00 in fabricating costs.

C.R.E.D.I.T. affords bending pre-fabricated pipe. For example, if there are two elbows to be welded (one on each end) onto an offset, say, 12" pipe X Sch., 160 wall. If the elbows can be "automatic-welded" to the straight pipe before the pipe is bent - this takes about three (3) hours to "automatic-weld" each elbow (6-hours). The apparatus affords the offset to be formed with the elbows on the pipe. If the offset has to be bent first, then to "hand-weld" the elbows takes about fourteen (14) hours for each elbow (28-hours). To be able to bend the pre-fabricated piece saves the labor cost of 22 man-hrs,, or over 400% of the fabricating costs.

I have had cost estimates from reliable manufactures to have the apparatus built in accordance to my specifications. I have reviewed these costs quite carefully. Also, I have compared these estimates of costs to the costs of other bending equipment. By this comparison, the costs of building the apparatus is very, very modest. The unlimited bending afforded by this apparatus results in a general overall savings in bent pipe fabricating, which are not provided by the common procedures of the present methods of hot pipe bending. The following are some additional savings that will be derived:

Savings in waste material by being able to hold to close computations; more empty pipe bending is afforded by the rapidity of C.R.E.D.I.T. because the extra sand-heat is not needed to keep the pipe hot; savings in furnace gas by the shorter heating time required to heat empty pipes. Forming the compounds w ill save 80% of handling time and shop space. Bends can be formed up to a complete circle - 360-degrees without a butt weld. The first step towards keeping costs down begins with bending. The pipe has to be bent, so, why not bend the compound and save the costs of having to fabricate it?

This development provides more than twenty (20) distinct money saving features. But in order to be more precise in the overall economy and efficiency. Here I will ask four (4) questions to try to determine your need for C.R.E.D.I.T; and at the end of each question I will try to give a brief outline of what I have to offer.

First question: IS QUALITY BENDING (FULL-AREA, ACCURATE ANGLES) A PROBLEM? . The design, method, and accuracy of the apparatus produces full-area, precision bends of the highest quality, without distortions.

2nd question: IS ALLOY PIPE MORE DIFFICULT TO BEND THAN MILD STEEL, BECAUSE OF THE SLOW BENDING PROCEDURE? The rapidity afforded by my invention offers safety for alloy pipe bending by allowing the bend to be finished while the pipe is at the proper degree Faarenheit. Bends up to 90-degree angles can be formed in less than three (3) minutes.

3rd question: COULD YOU USE TWICE AS MUCH BENDING? This is possible to do, and even more. With the increased productivity which the development provides, and with the simplified apparatus enabling even helpers to become qualified hot benders in a matter of a few months - you can have as many benders as needed. Bending can be done by three (3) shifts if necessary.

4th question: IS BENT PIPE FABRICATION COSTS (WELDING AND CORRECTION-WORK) TOO HIGH? Fabricating costs "WILL" be overwhelmingly reduced by the use of my development, which provides for quality, production, and unlimited compound bending - eliminating butt welds and other secondary operations. Often, there is a labor cost savings of several hundred percent (over the present methods) of bent pipe fabricating costs.

When wrinkle-free, full area - quality bends can be obtained at a production rate; and unlimited compound pieces can be formed, then, a "substantial" savings in bent pipe fabrication can be realized. I am prepared to show and to prove these savings and productivity (clearly and satisfacdtrily). I have a scale model of the apparatus which is calibrated to exact tolerances. I am able to demonstrate, by forming the various compounds (to exact dimensions) with flexible miniature pipes (scale sizes from 8" to 24" diameter). The accuracy and the efficiency of the apparatus and the simplified procedure of hot bending can be shown in its entirety.

Mr. Wesler, I am sending Lieber a letter which describes the development in greater detail.

Yours very truly,

Inc.

Henry O. Crippen

West

~~PLT. EXH.~~ 7 for Ident.

DEFT EXH. D. HORN

OCT 16 1973

TUBECO INC.

123 VARICK AVENUE
BROOKLYN, N.Y. 11237
PIPE FABRICATING
TEL. (212) 386-0700

March 20, 1968

Mr. Henry Crippen
601 East 167th Street
Bronx, N.Y. 10456

Dear Henry:

Thank you for your recent letter regarding C.R.E.D.I.T., which you advise is your invention for a new hot bending concept for pipe.

We are in the pipe bending game and we think we have considered most techniques possible, as you know from your employment in our shop, but, Henry, we're still not too old to learn. However, we do not wish to be in the position of having to be concerned whether procedures we have used or may use were based on our ingenuity and experience or on your idea.

Therefore, we will not permit you to disclose any idea to us unless you waive all rights to any compensation whatever from us for our use of your idea or the use of it by any other company to whom we may disclose it. This would mean that we would be the sole judges of the novelty and worth of the idea, and that any payment to you would be entirely voluntary on our part.

If you would like us to consider your idea, please contact the writer in writing to have our lawyers draw up such an agreement, which we would be happy to furnish for your signature prior to our examination of your concept. Unless and until the agreement has been signed, you are cautioned not to give us any technical information and we request that you do not communicate with us or our employees about any trade or technical matter.

Kindest regards.

Yours very truly,

TUBECO, INC.

Allan B. Wesler
President

ABW:ck

cc: Leonard M. Lake
Lyber Katz


TUBECO INC.
PIPE FABRICATING

Although more than 30 years old in pipe fabrication, Tubeco is young in ideas. Tubeco's computerization makes the purchase of pipe fabrication a pleasant and exciting experience in the computerized age of the present. Yet Tubeco continues to place stress on the conservative aspects of skilled craftsmen giving close attention to every step of the fabrication process. This includes the items which are sometimes overlooked, such as instant retrieval of documentation for all materials; quality control personnel responsible directly to corporate officers active in management; permanent metal marking of all final assemblies; and, finally, delivery schedules that are maintained.

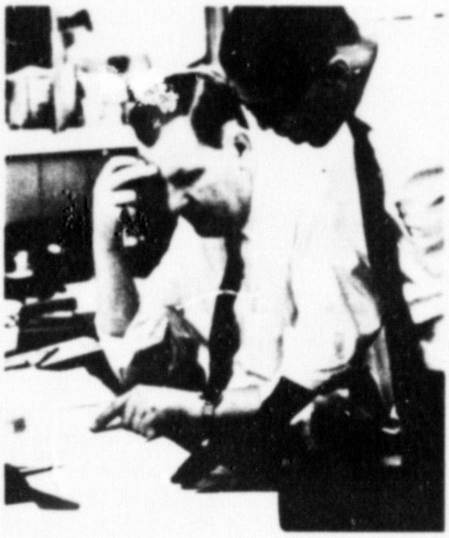
Tubeco offers the purchaser and his engineering representative some advantages that are unique.

In Tubeco, one finds a major national pipe fabricator who is also a major national distributor of all of the materials for fabrication. The total requirements of a project are supplied from one source and delivery dates are faithfully met. When a rush engineering change becomes necessary, the materials needed can be drawn from the enormous piping inventory, and the surplus items readily returned. There is no waiting, no trouble, and no expediting expenses for the purchaser.

Planning

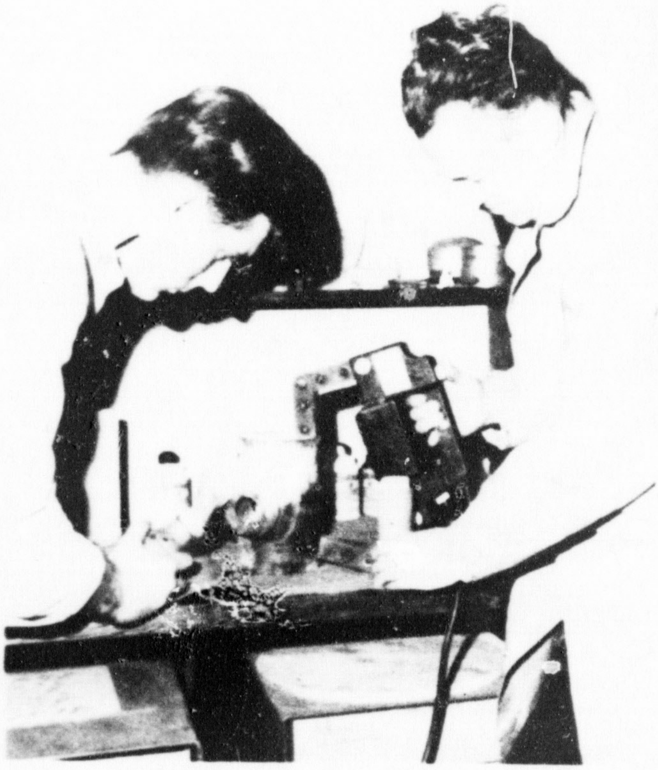
At Tubeco, the status of each job is entered into a computer for simultaneous control of the customers' delivery dat- - the specified priority sequence, the location in the job area, the piping system, and the job completion. The production status of the project is continuously followed for comparison with these requirements, and the reports of this status are available to the purchaser. This computerized control integrates the Tubeco engineering department's work schedule with the delivery of outside purchases and the fluctuating requirements of the production floor to insure on-time delivery. Computer procedures also are used at Tubeco to prepare each spool bill of materials for the engineer. The total bills of materials of the completed job, collected by like-item or by any specified piping systems, are readily available for analysis purposes.

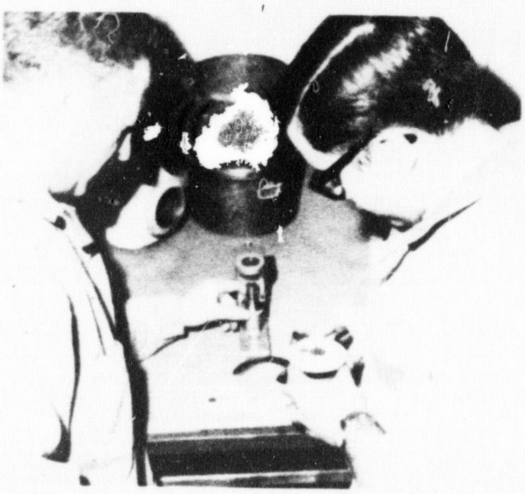
Tubeco's computerized approach applies particularly well to a unit-price project. The Tubeco program utilizes the price book information, weights and the job discounts stored in the computer system to convert the bills of material data accurately into a precise invoice for each shipment. The items are further consolidated by Tubeco into a checklist, presenting in a simple table a summary of all of the labor and material items included in the invoice. Thus, on this one sheet the purchaser conveniently checks all of the invoicing details for scores of individual spool drawings.

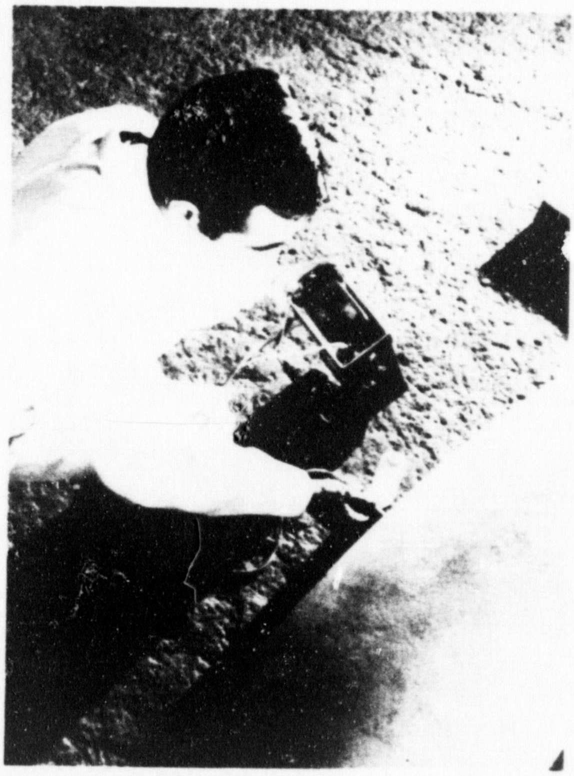


Control of Materials

Materials drawn from the Tubeco inventory are recorded and controlled by a computer procedure which provides ready access to the source and to the documentation of the items utilized. When materials are purchased from outside vendors they are received in a separate wing of the Tubeco building. All materials must be approved by Tubeco's quality control personnel before being used for the fabrication of any project. Non-approval materials remain in this segregated wing until the disposition is made.

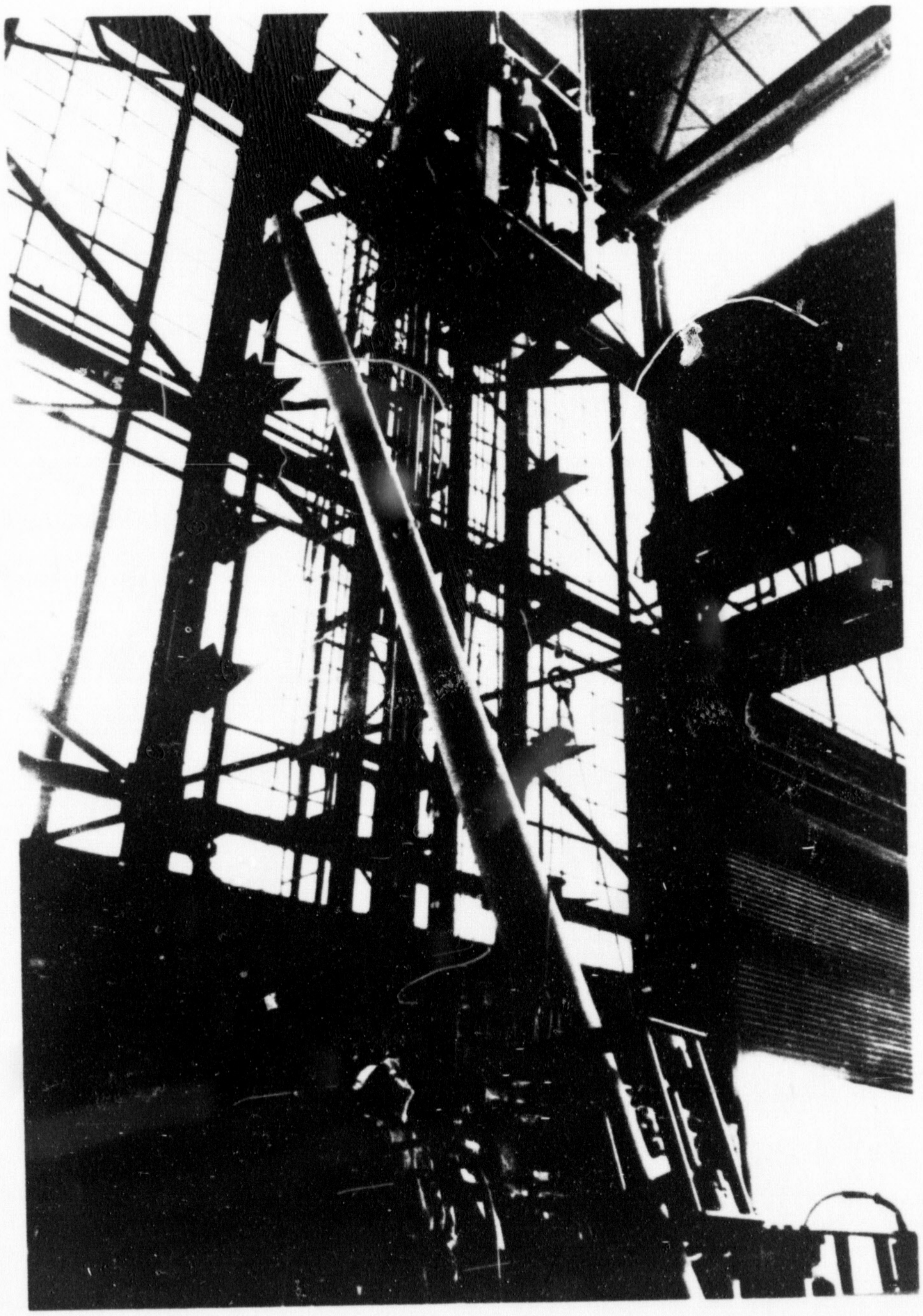






Fabrication by TUBECO

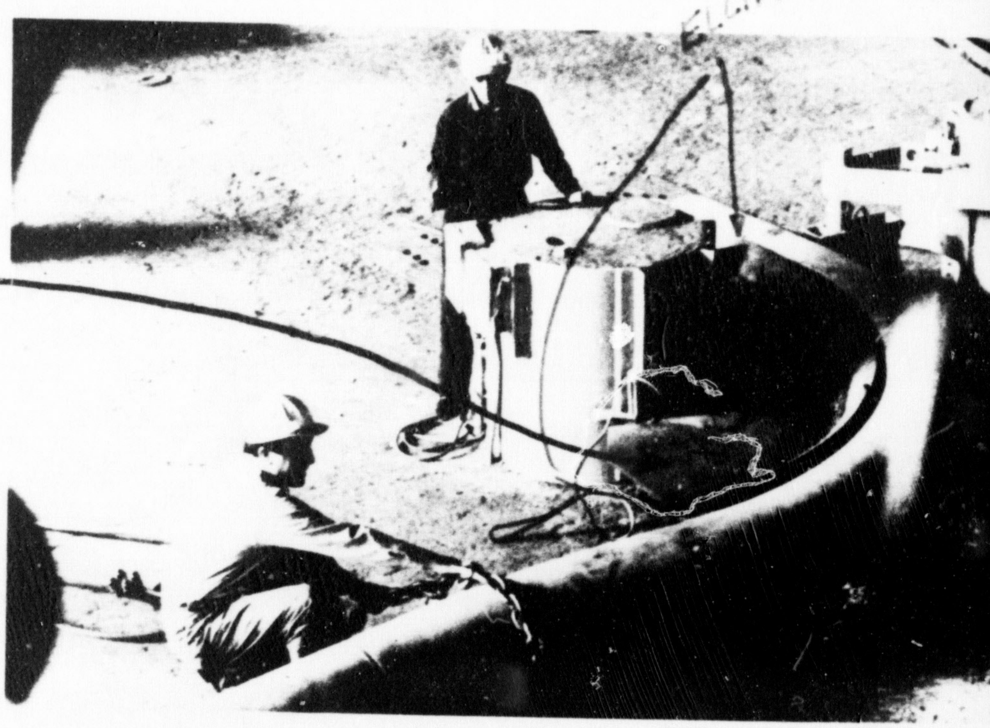
Fabrication is performed at Tubeco by highly motivated craftsmen who have progressed within their work categories by their skill in successively higher qualified procedures. Exotic alloys, ferritic and non-ferritic materials are regularly in process on the plant floor to the highest standards available in the industry. Bends of heavy and light wall pipes are produced on unique Tubeco equipment, with all heating operations for bending, annealing, and for intermediate requirements constantly regulated by multipoint recording controllers. Tubeco is one of the primary sources for the world's requirements of large size pipe bends, with facilities to handle the maximum sizes utilized or anticipated.

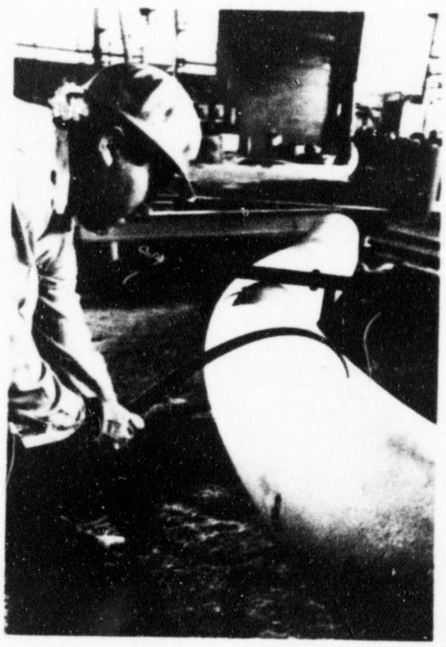


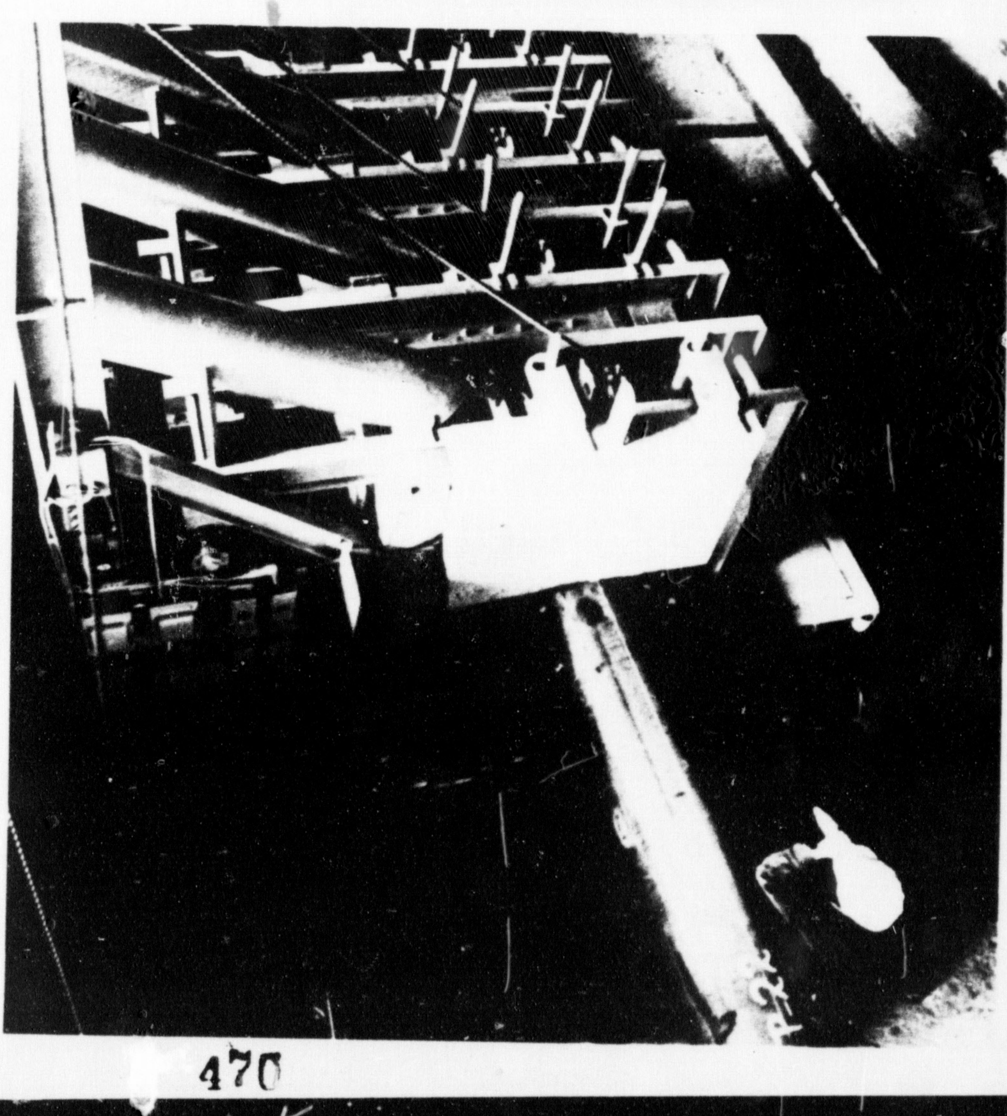
Katz 2
10/23 73

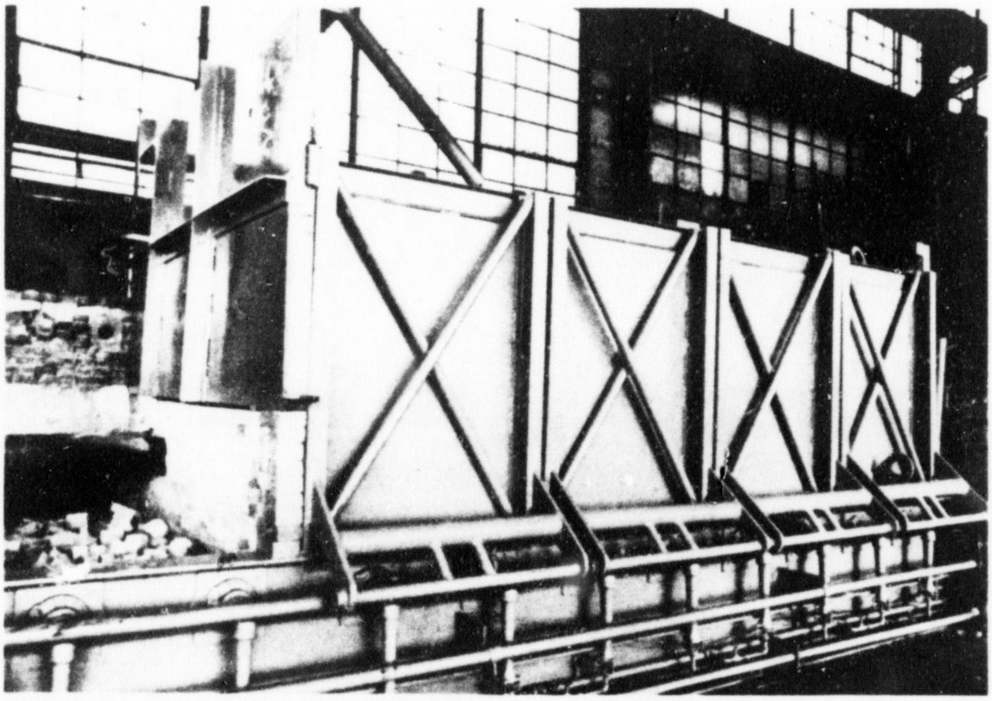
ELLIPTICAL CUTOUT

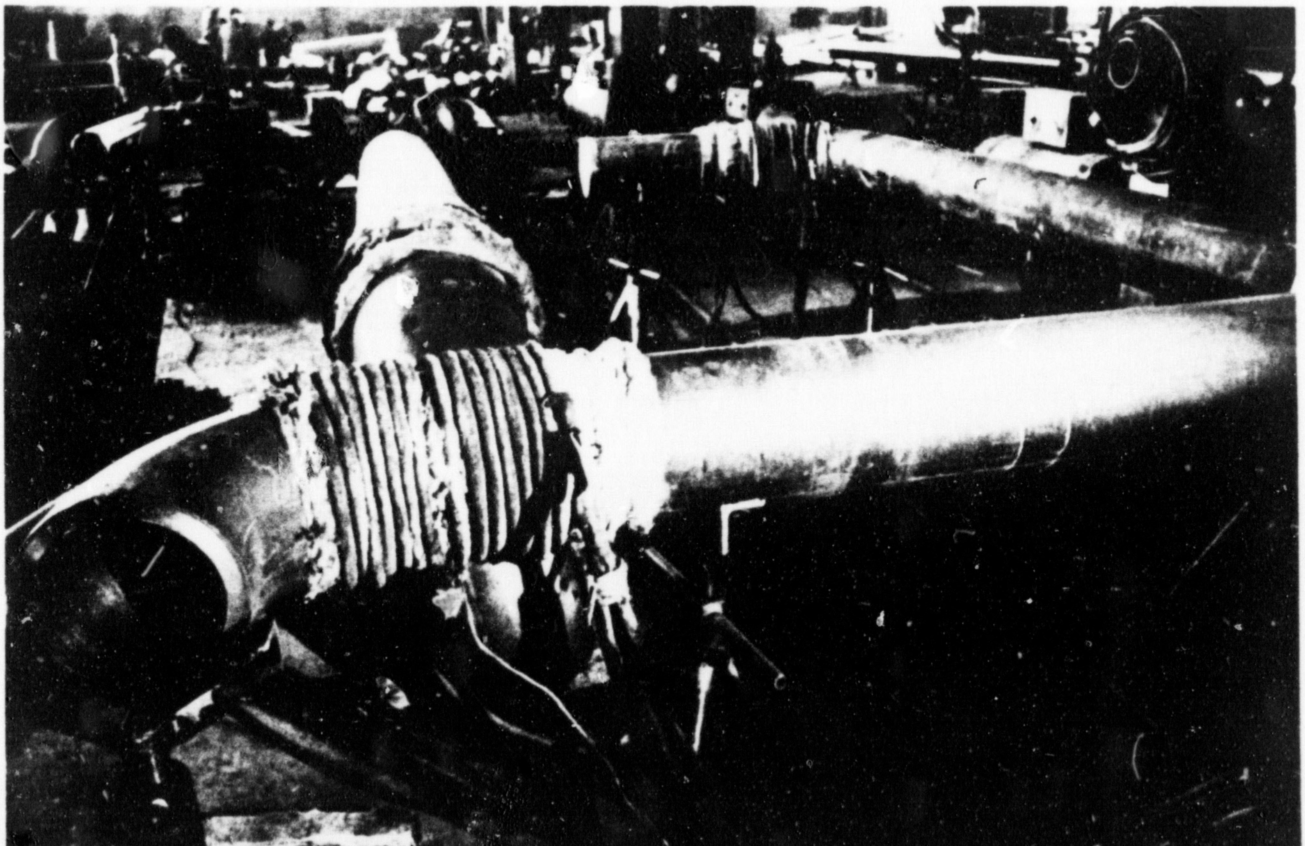
die-web plate





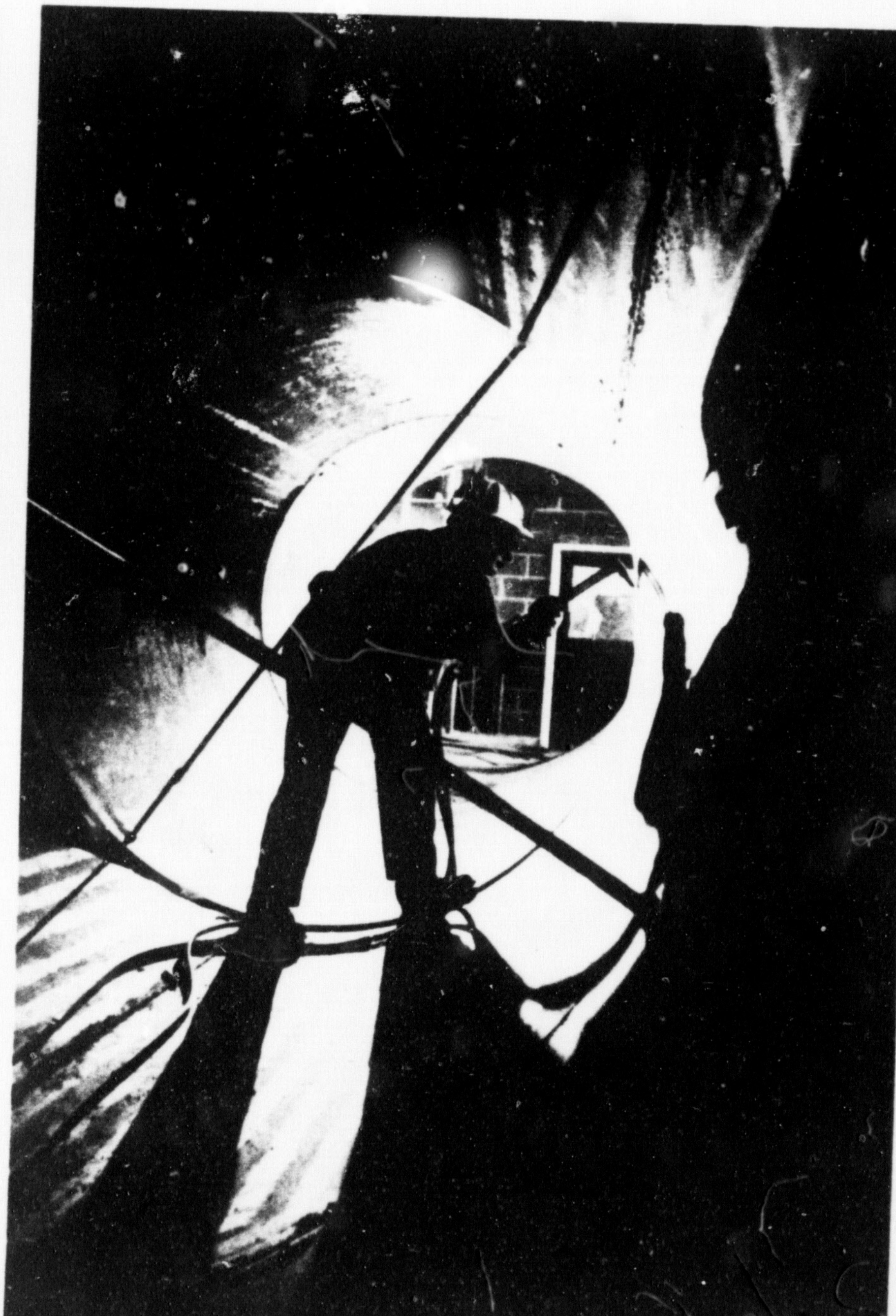


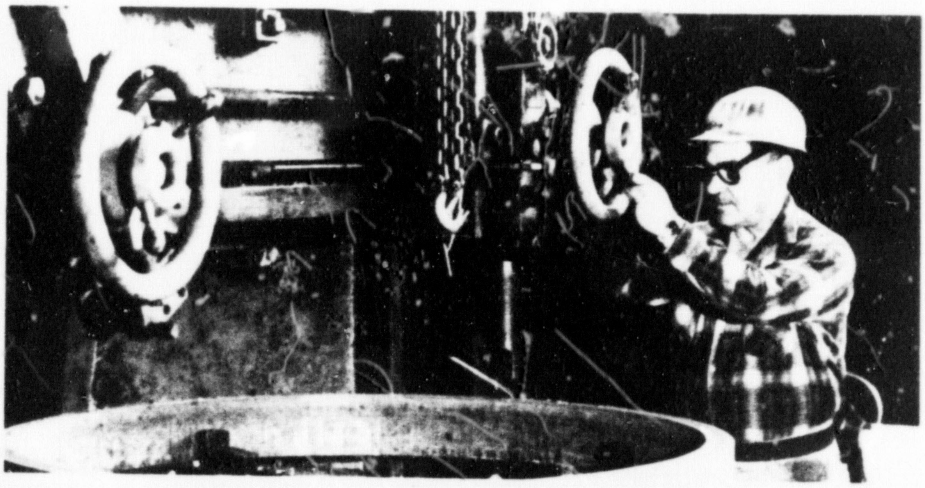


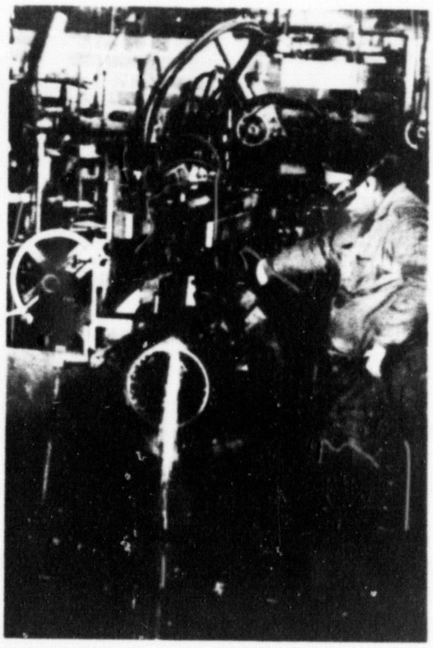


Fitting

Working with edges uniformly prepared by torch or machine lathe, or with bevels machined on special equipment after the bending operations, piping components are carefully fitted together suited to the subsequent welding operations. Tubeco's fitters have the means to produce end-match tolerances which exceed the most critical requirements of the purchaser, including the checking of critical assembly dimensions by the use of optical instruments. Alloy fabrication for nuclear plants is performed in a reserved area equipped with alloy-clad tables, low stress alloy tools, steam purging and chemical cleaning apparatus, especially equipped for such work.

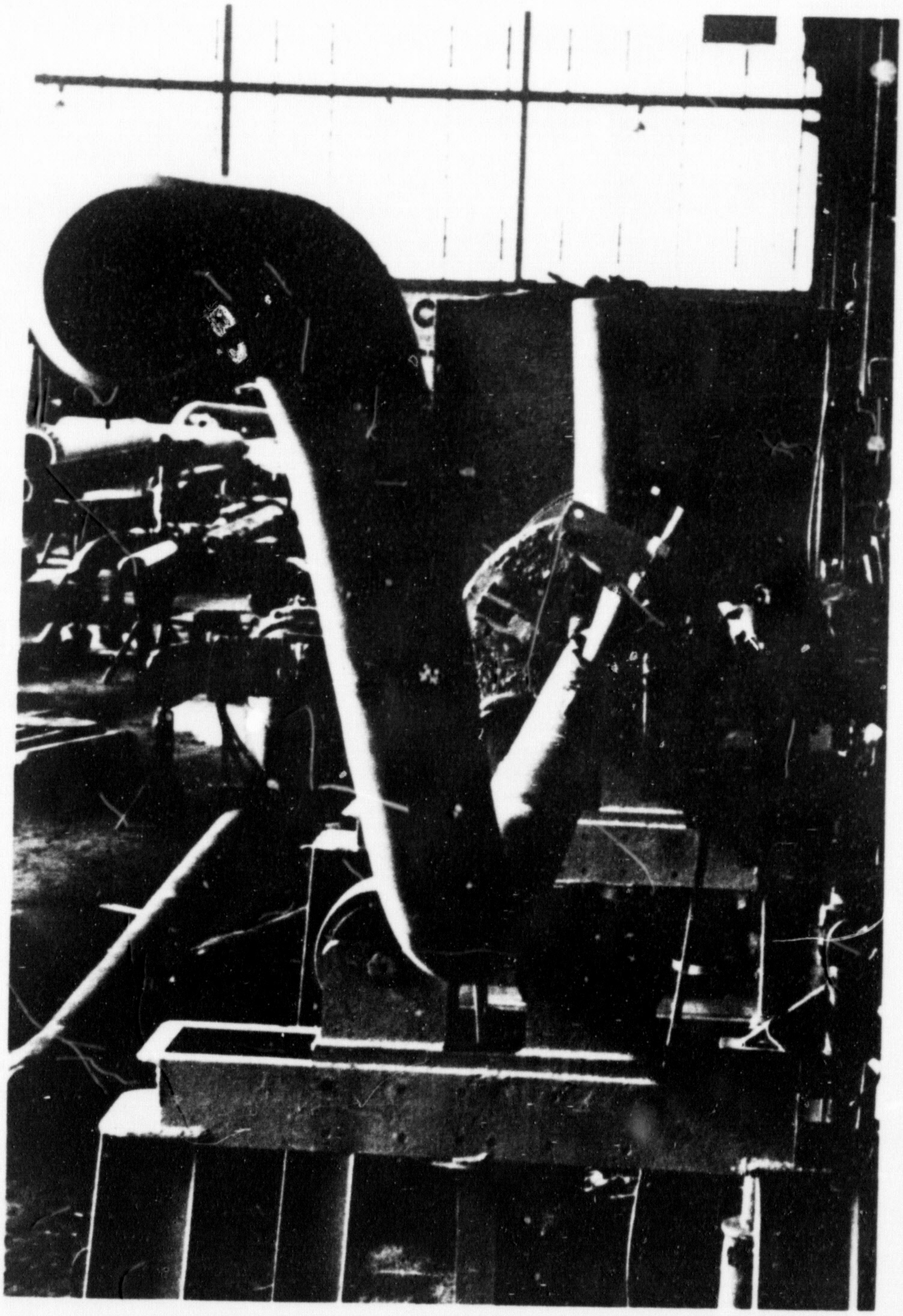


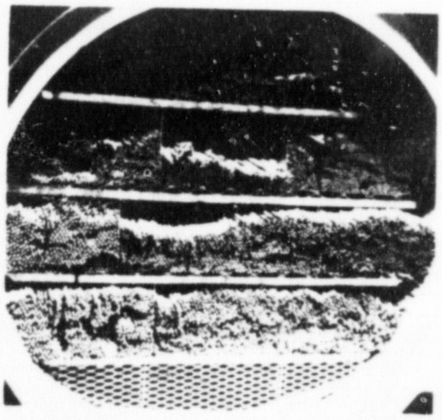




Welding

Welding is performed, to the maximum possible extent, by automatic and semi-automatic welding processes. Specially designed equipment is used to rotate the bent shapes for automatic welding. This equipment is motorized on tracks which permit the work to be positioned over deep floor pits for rotation of the largest piece dimension. The mig, tig and coated electrode methods utilized by Tubeco's skilled welders are continuously checked by Tubeco's quality control personnel for conformance to the best industry practice. Coated electrodes are stored in dry heat boxes before each use by the welders.

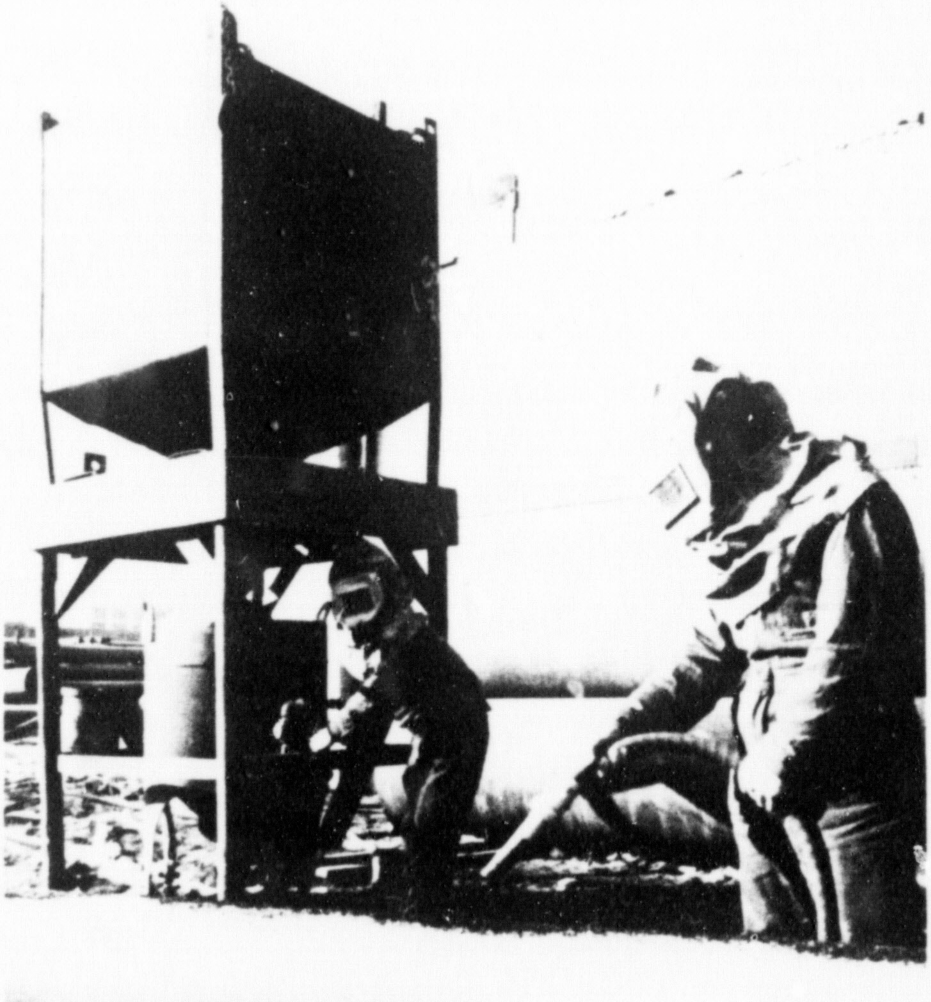


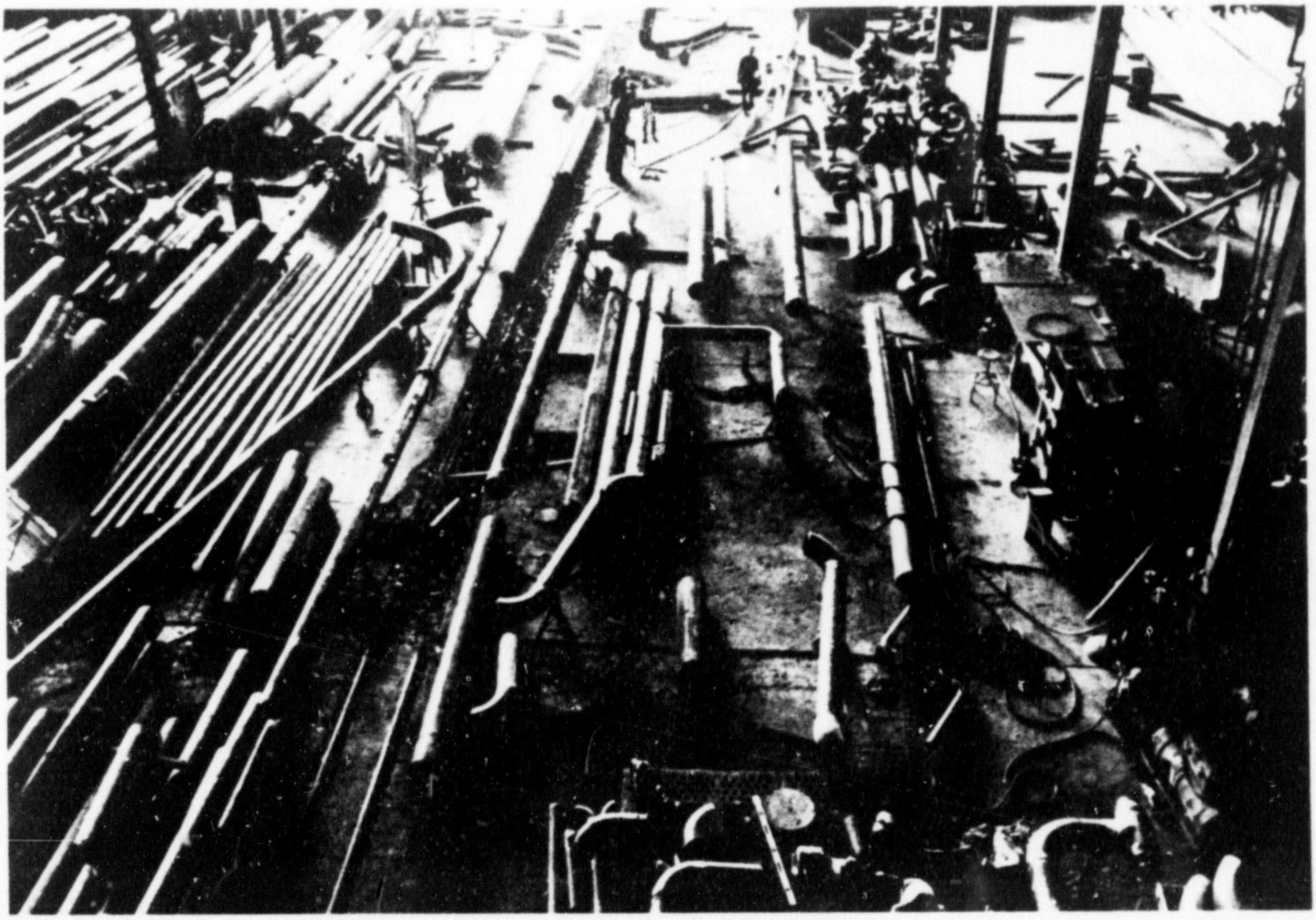


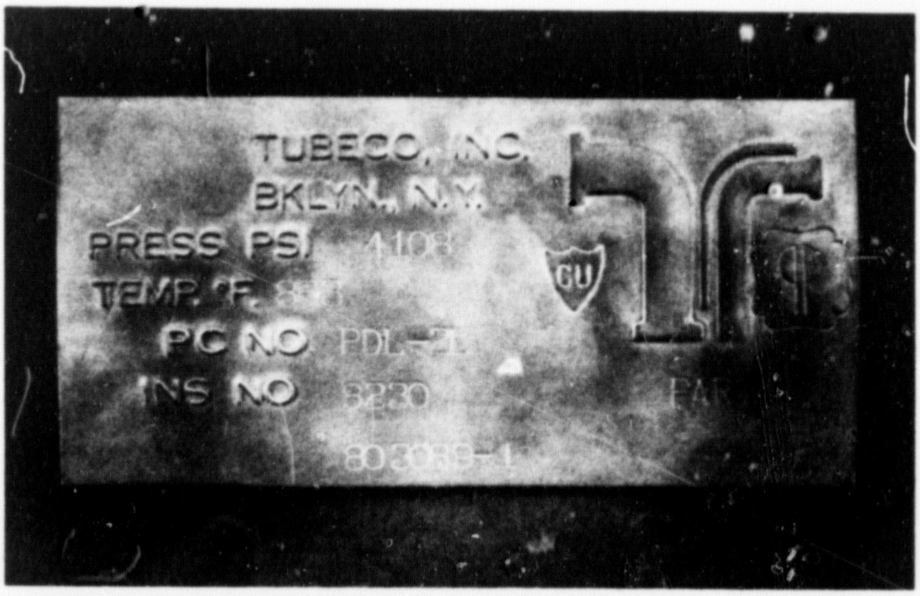
Finishing Operations

Care and attention to detail continue through the final steps of Tubeco's fabrication process. Grit and sand blasting operations are carried on in a separate area, followed by coating and shop painting. These operations are performed by workers with long experience in satisfying the erectors' critical requirements.

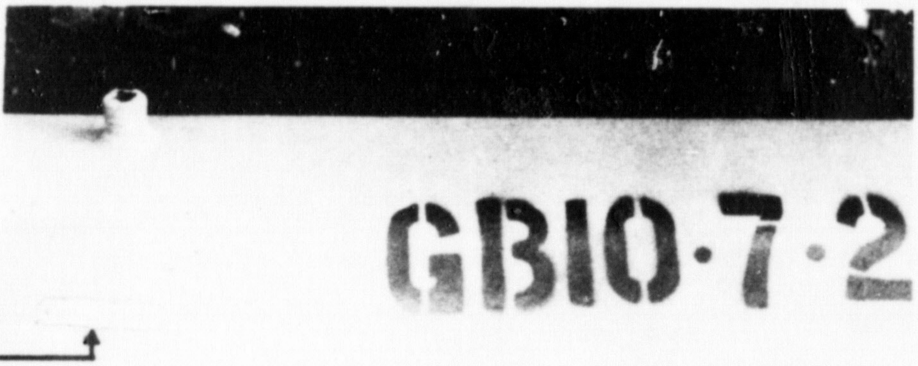
After surface preparation, each assembly is carefully capped and protected as specified. Then it is loaded, braced and strapped with heavy duty steel strapping to assure that the high quality pipe assemblies shipped from the Tubeco plant arrive at their destination in excellent condition for field installation.

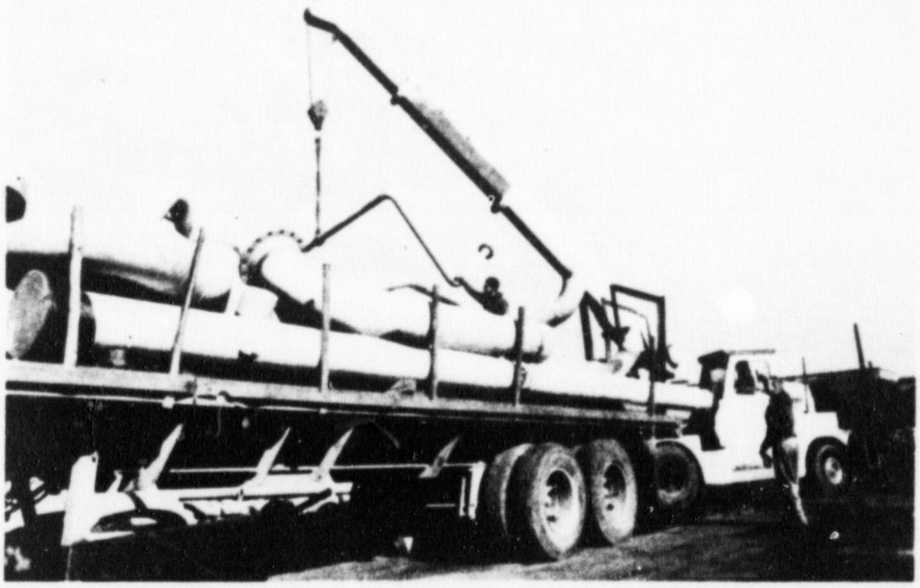






The individual piecemark numbers are embossed on rustproof metal tags affixed to the final assemblies. Identifying marks are, in addition, painted in large characters on the pipe surface.





TUBECO receiving and shipping facilities

- Two separate railroad sidings
- Truck receiving and shipping
- Plant readily accessible to all New York port facilities
- Barge loading on full length of Tubeco property

TUBECO INC.
123 VARICK AVENUE
BROOKLYN, NEW YORK 11237

VETS. NMC DEF. EXH. 3

601 East 167th Street,
Bronx, New York 10456

Mr. Lieber Katz - General Manager
Tubeco Inc.
123 Varick Avenue,
Brooklyn 37, New York.

March 11, 1968

Subj.: Hot Pipe Bending Apparatus & Method

Dear Lieber:

Realizing that we did not get too deeply into details during our (as Mr. Wesler says: four-hour) talks about my development. So, I decided to spell-out a little more about the efficiency and the economics of it. The apparatus of the invention is called C.R.E.D.I.T. An application for a patent on C.R.E.D.I.T. has been filed, and is now pending in the United States Patent Office.

C.R.E.D.I.T. has many advantages over methods currently in use. This equipment, method and knowhow provides every convenience for simplified hot pipe bending, from size 8" to 24" diameter pipes; from standard wall pipes up to high pressure piping of unlimited wall thickness.

As pipes must be bent to varing radii in order to fit into the space alloted for them; this apparatus provides every conceivable radius of bend from 30" (even in 1" increments) up to twelve 12')feet radius, or more.

Also, as pipe bends must be fabricated into various compound pieces; my invention provides for the compounds to be formed and saves the fabricating costs. Fundamentally, this apparatus provides for great economies and efficiency in all phases of bent pipe fabrication.

(a) provides for a pipe to be bent up to a complete circle of 360-degrees without welds;

(b) provides for the compound bending of 3, 4 and 5 bends in a single pipe without butt-welds;

(c) provides bending without the use of water to control the bend, as the use of water causes spot-hardening of the bending material - frequently resulting in buckles and other imperfections;

(d) offers a rapid system for the safe bending of alloy pipe by enabling the bending to be finished at the proper degree Fahrenheit, eliminating by its bending speed the losses of heat resulting from using present slow methods;

(e) will permit a 90-degree bend to be formed in a pipe in less than three (3) minutes;

(f) accuracy will cut costs by elimination of waste material due to being able to hold to close computations;

(g) prevents over-bending and under-bending of the angles because of the accuracy of the apparatus;

(h) permits the most complicated compound bends to be formed with zero (no) tangents between bends;

(i) permits more empty pipe bending by not needing the extra sand-heat to keep the pipe hot;

(j) provides none-flat full-area bends through the use of my design, supplemented by instruction in the "art" of bending;

(k) provides interchangable two-way bending, affording clockwise and counterclockwise forming of angles, which enables identical compound pieces (right and left) to be formed for each side of a construction;

The synchronization of the apparatus is such: That a pipe can be formed into a rotation (zero tangent) compound on three (3) different radii - using clock and/or counterclock bending.

Lieber, I have finally put all of my years of experience, research, hard work and accomplishments in hot pipe bending (which began more than a quarter century ago) into a "simplified" development. With this invention so many problems are removed the result is a marked increase in productivity, and a greatly reduced cost of bent pipe fabrication is realized by the reduction in butt welds and other secondary operations.

In an attempt to show the savings with my invention and to translate these savings into something tangible, I have as only one example estimated the saving in time based on the elimination of two butt-welds in a 16-inch pipe with a 2.250-inch wall. The following would be saved just by eliminating the two butts:

Layout time per bend 2-men 1½ hrs = 3-hours X 4=	12 hours.
Machine beveling of the four ends	7 hours.
Machine boring of the four ends	7 hours.
Fitting of the four bends	12 hours.
"Hand-welding" the two butts	44 hours.
Total man-hours	82 hours

I have not included in this the economy resulting from the elimination of the need for radiographic inspection and stress relieving of the two butt-welds.

However, this cost is based on the assumption that the bends are accurate full-area bends. There is no way to determine what the cost will be when trying to correct distorted pipe bends: Re-heating; re-bending; jacking-out wrinkles; hammering-down buckles; fill-in welding, and grindingetc. In most cases the cost for "correction" more than doubles the cost for bending.

The time required when fabricating these inaccurate (adjusted) bends is even more costly if other attachments, such as lugs, flanges, nozzles, reducers, etc., are to be fabricated to the compound piece, because of the many adjustments that has to be made by the fitter.

Lieber, I realize that I have made some strong ascertains compared to the present methods and attainments in hot pipe bending, but I am prepared to substantiate these claims. If you think of my past performances over the years with the company, I'm sure you will recall many of my hot bending accomplishments that have not been attained or even attempted since.

I will try to refresh your memory by listing just a few of the various jobs. These jobs can be verified by time cards, dates and job prints: 1956 12" pipe x 2½" to 3" wall, fusion-welded (Chrome Molly) pipe. Foster Wheeler had previously bent the job. They had 66 welds and they cracked six pipes. We repeated the the same job and had 16 fewer welds. I reduced the welds to 50, tremendously reducing the fabricating costs by compound bending.

11-8-56 14" pipe x .375" wall, bent on 42" radius - not a single buckle; 5-15-58 job # 3300 12" sch 30 bent on 36" radius no buckles, 3% flat; The first 24" pipe bent in Carl Pipe. The ends were beveled in preparation for an offset - the pipe was ordered to exact dimensions. I bent it on nominal radius, holding the dimensions - and the ovality was less than 2%.

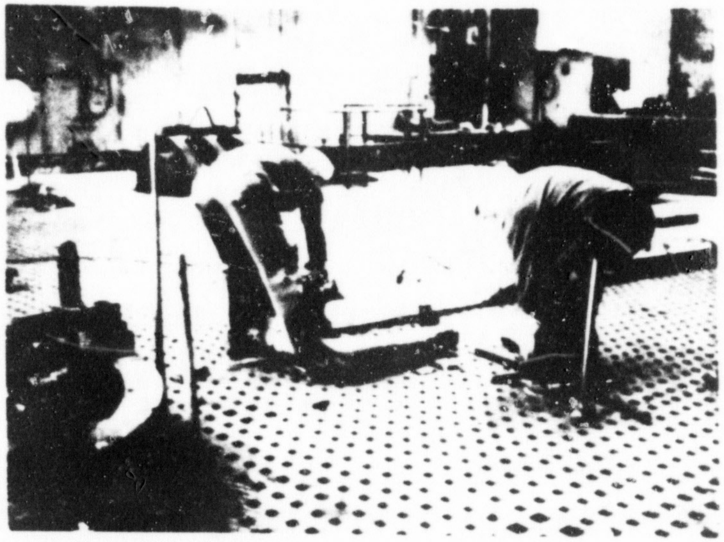
4-26-61 job # 3824 10" pipe sch 40 bent on 26" radius, 3% flat, but without a single buckle; 5-5-61 job # 3802 14"x1.263" wall bent on 56" radius, 1% flat; 5-15-61 job # 3759 14" sch 40 bent on nominal radius, came out 1% flat, without a single buckle; 9-2-60 job # 3729 12" sch 140 bent on 60", 70" and 84" radius - various offsets (zero tangents between bends) bent for a power plant in Conneticutt;

July 1961 job # 3836 10" x 1.62" wall P-22 bent on 50" rad., 91 bends, many pcs with 2 elbows welded onto the pipe to be held at rotated angles. Lieber, I just wanted to state some of these facts before we meet so when we meet I can do more listening and less talking.

Yours very truly

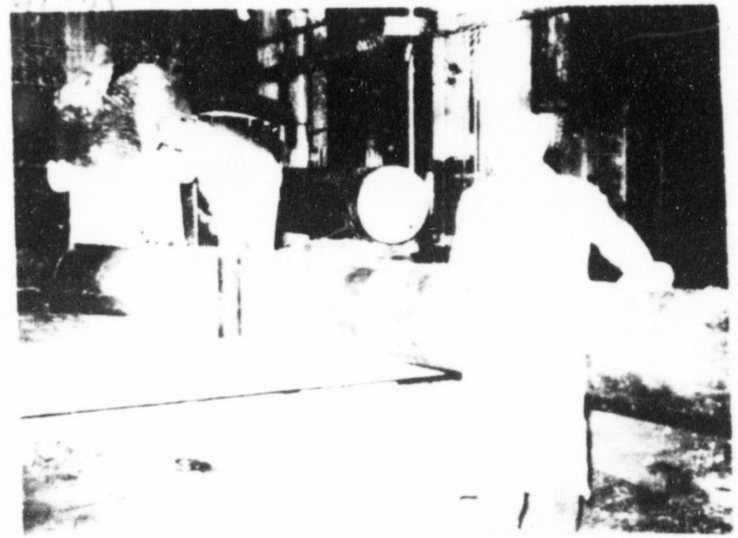
Henry O. Crippen

Henry O.Crippen

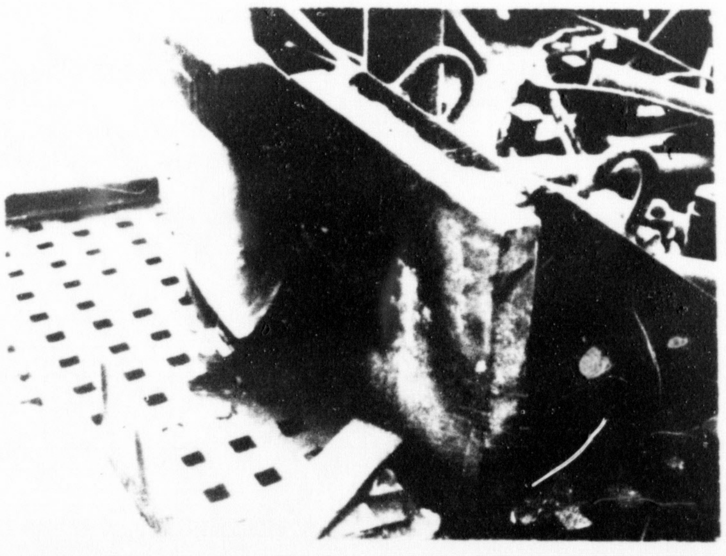


PDX 36-1

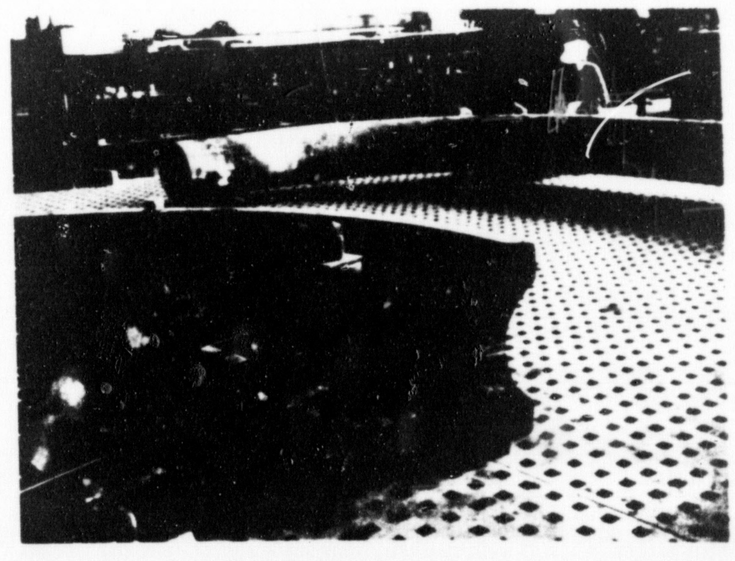
PDX 36-2



PDX 36-3



PDX 36-4



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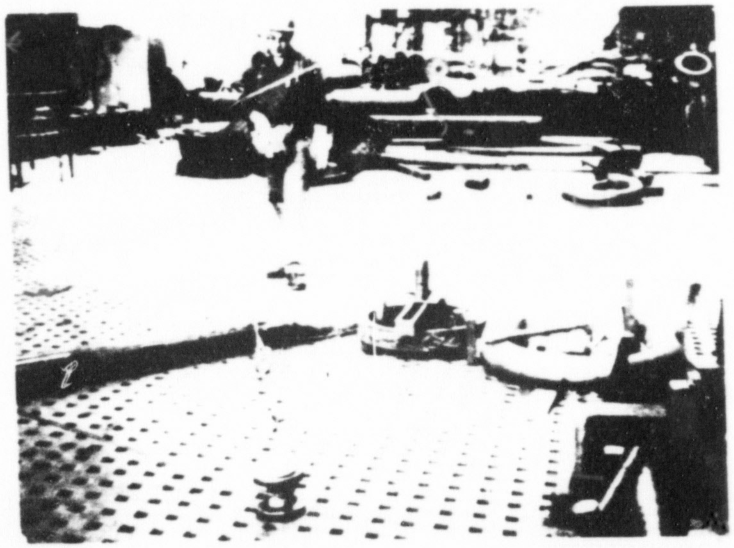
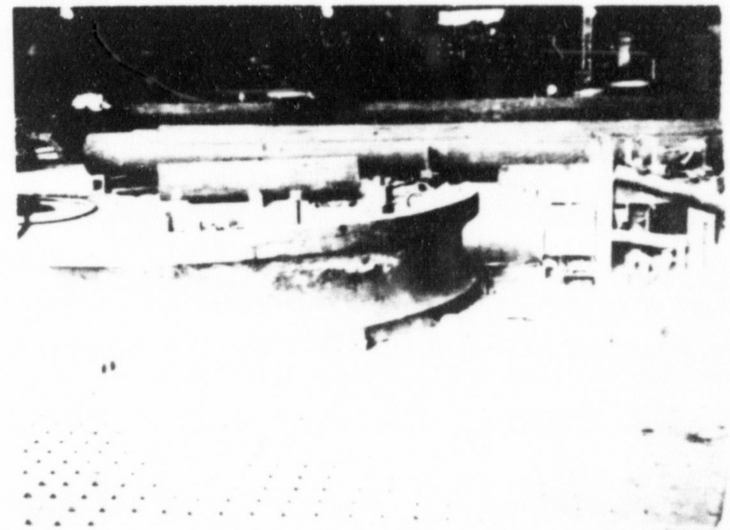
PDX 36-5

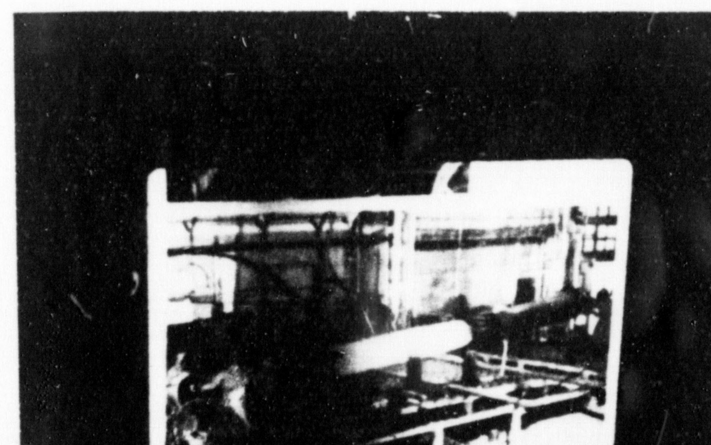




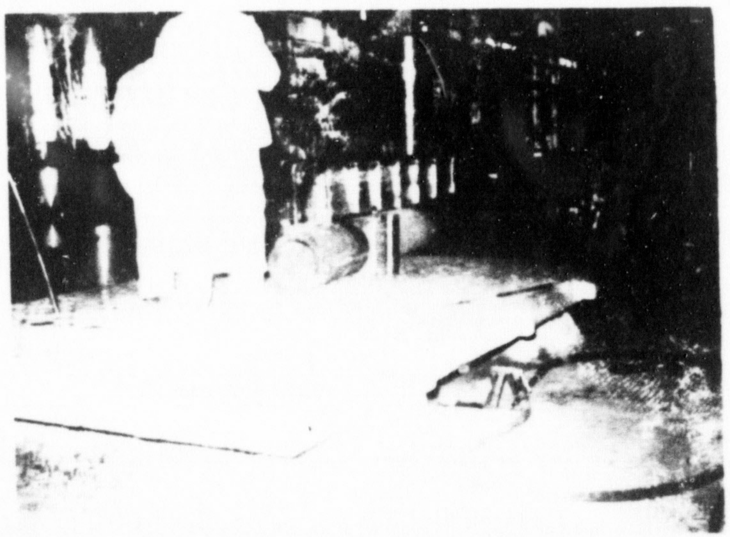
PDX 36-6

48C

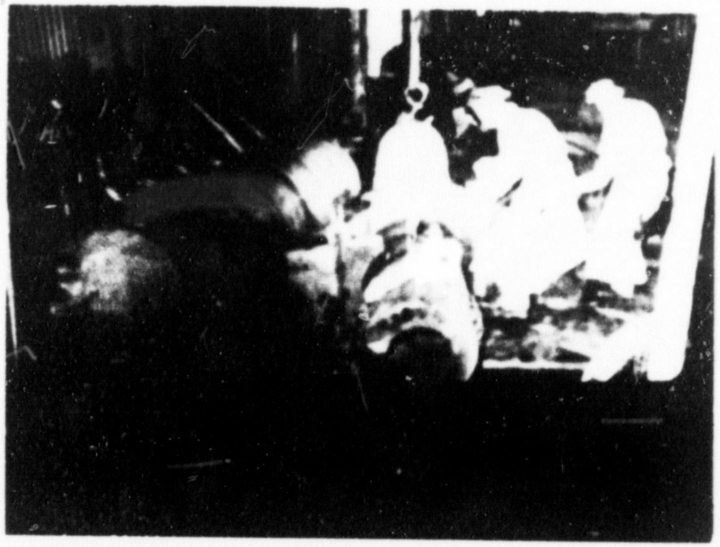
PDX 36-8



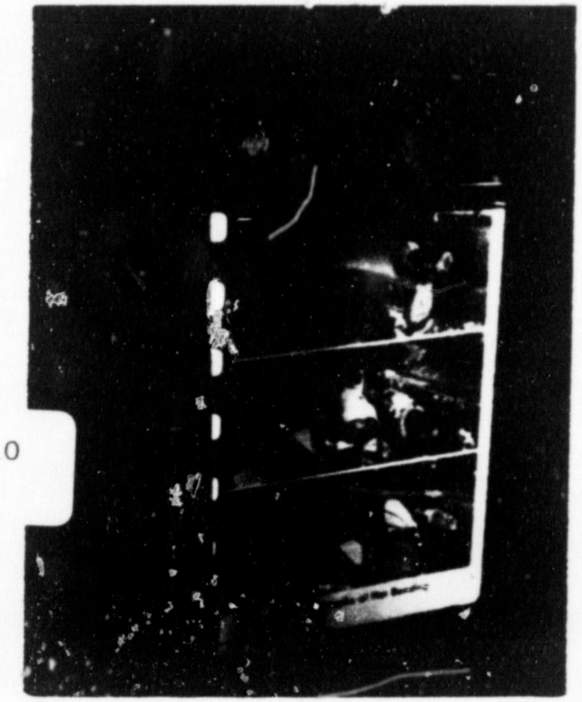
PDX 36-7

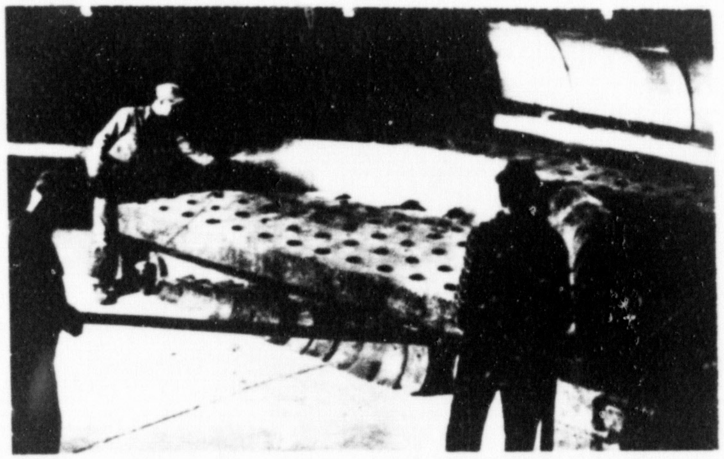


PDX 36-9



PDX 36-10



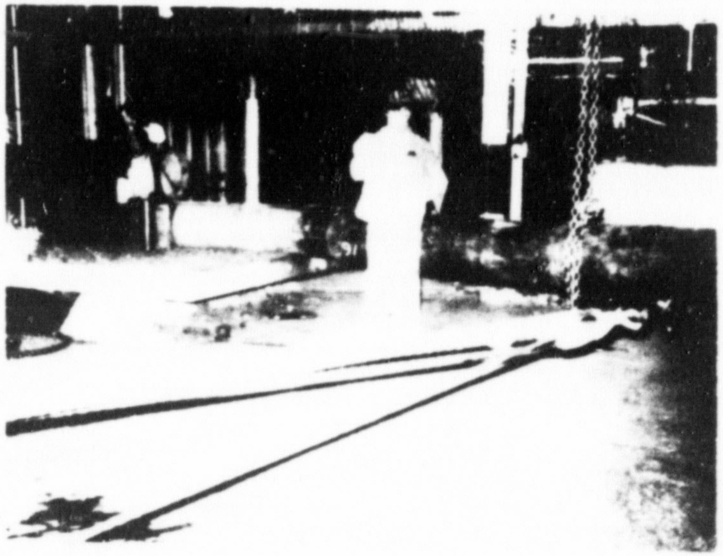


Dimensional Check of a Completed Hot Bend

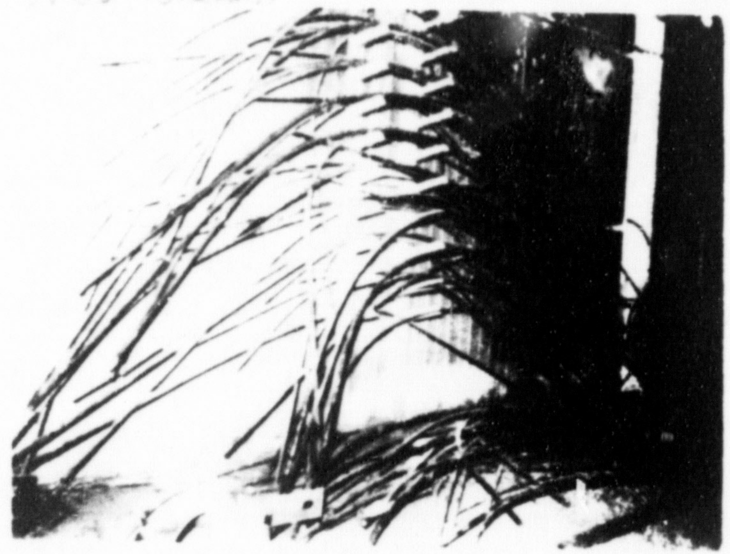
PDX 36-11

PDX 36-12

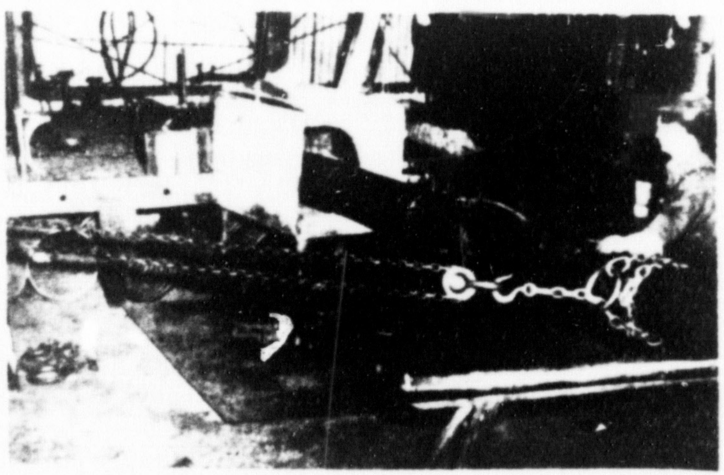
PDX 36-13



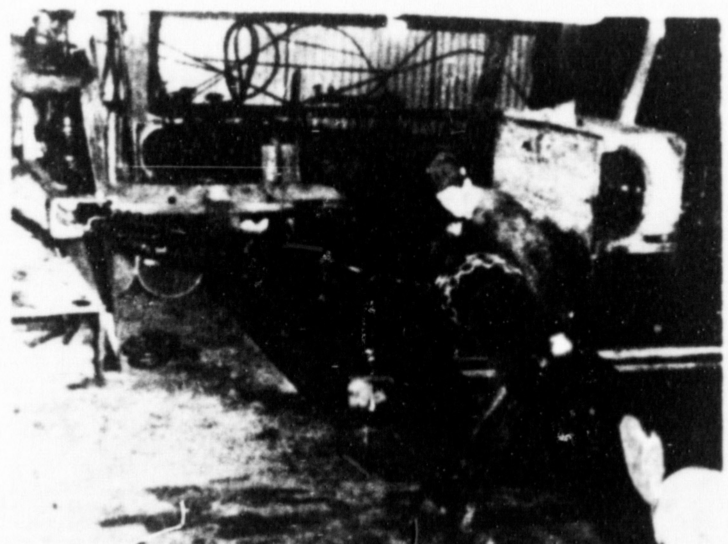
PDX 36-14



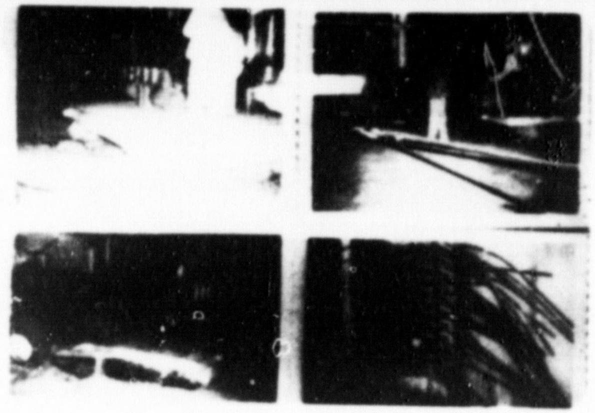
PDX 36-15



PDX 36-16

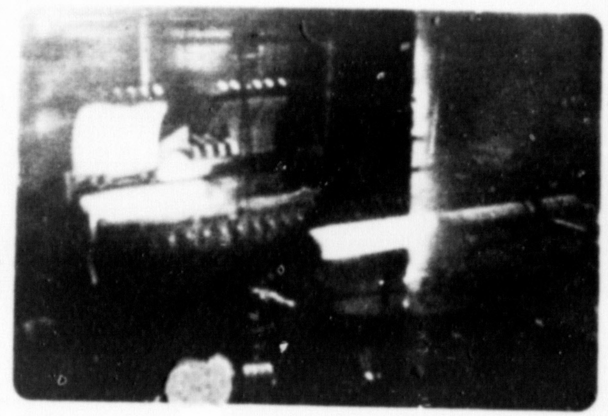


PDX 36-18

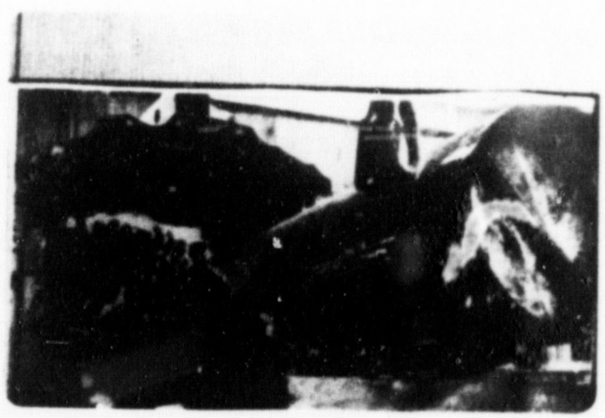


PDX 36-17

PDX 36-19



PDX 36-20



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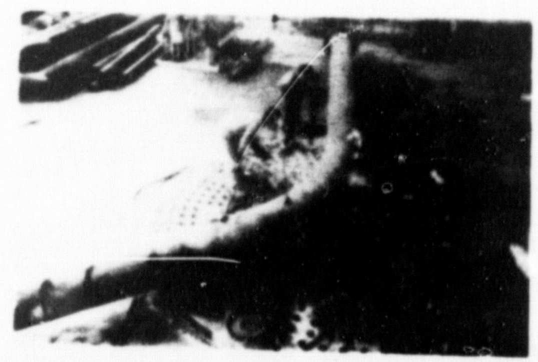
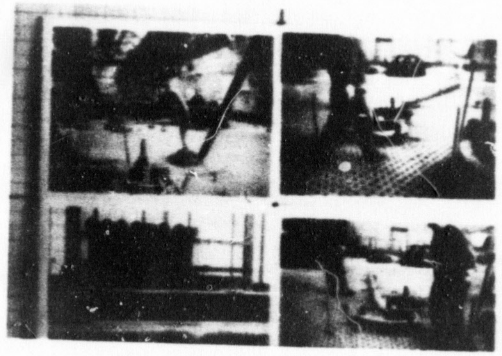
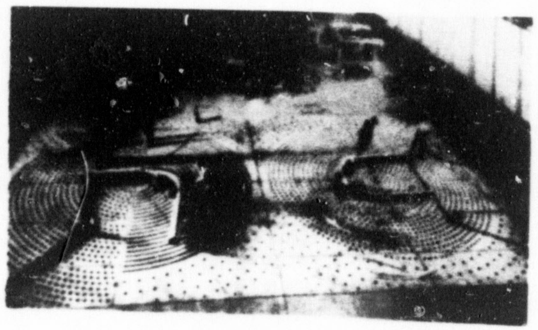


PDX 36-22

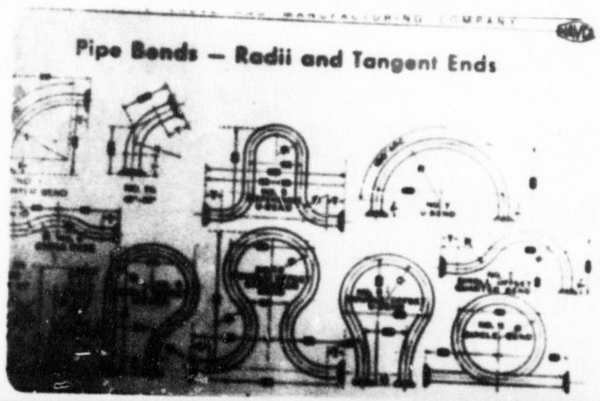




PDX 36-23

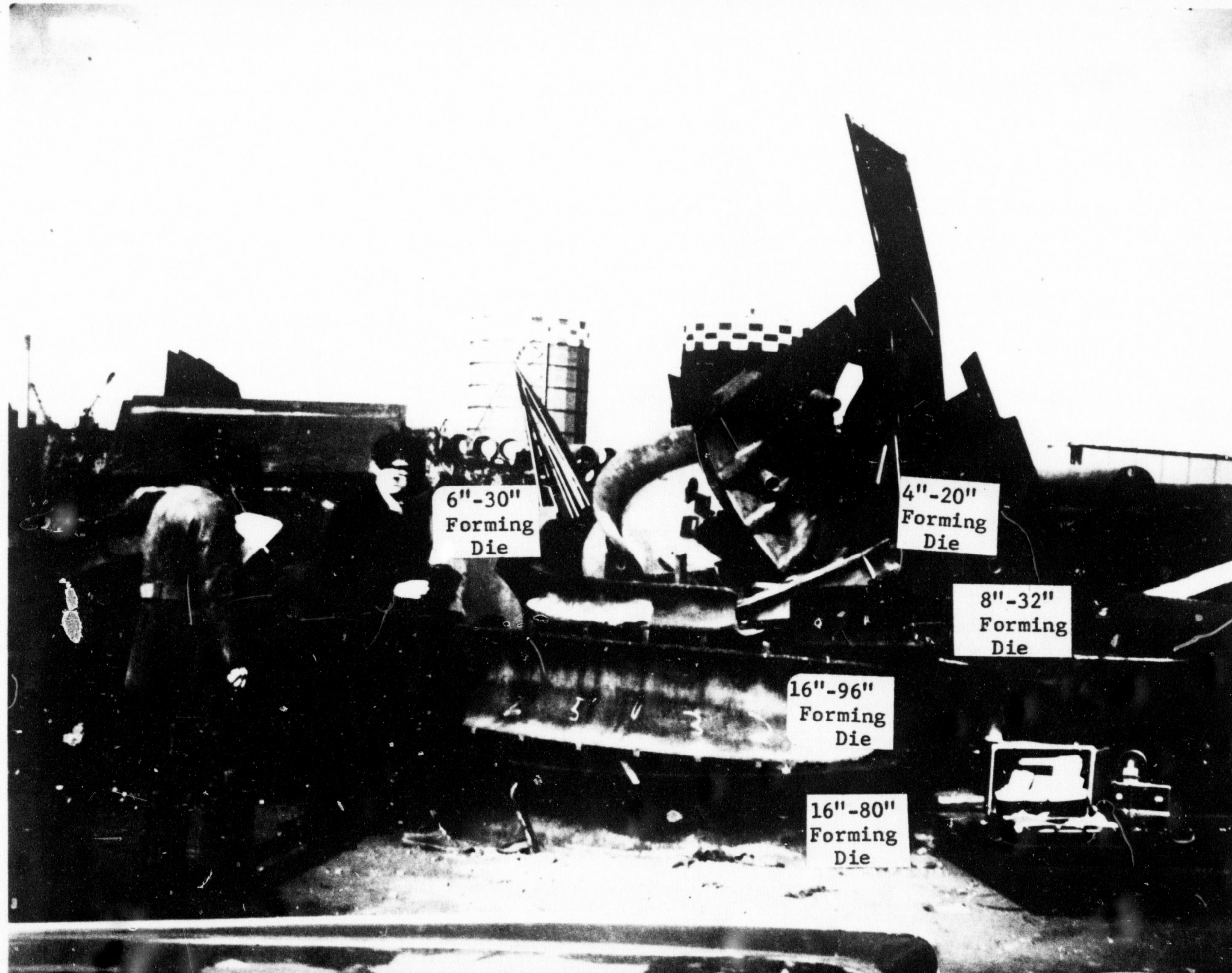
PDX 36-24

490



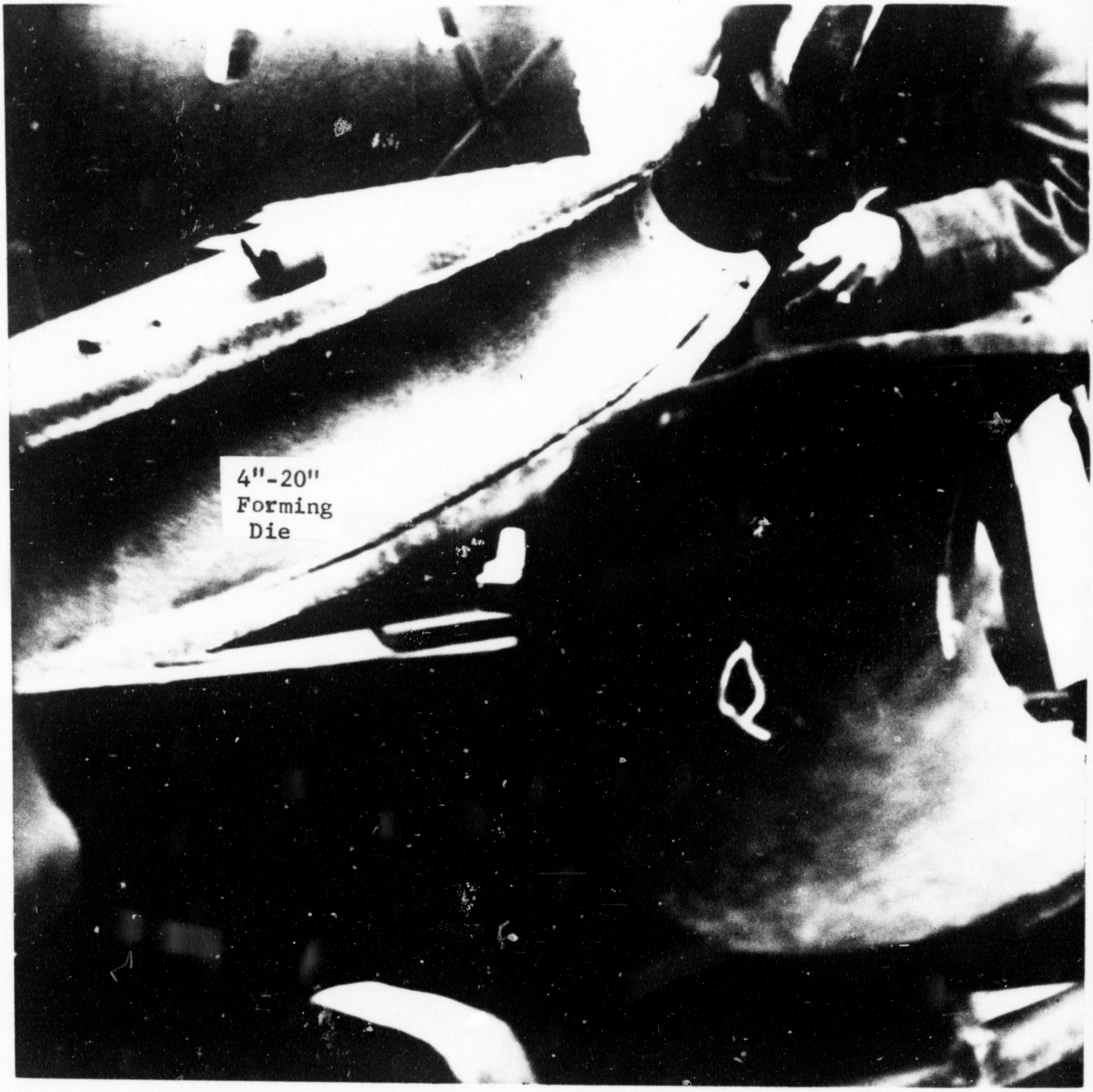
PDX 36-25

EXHIBIT 1

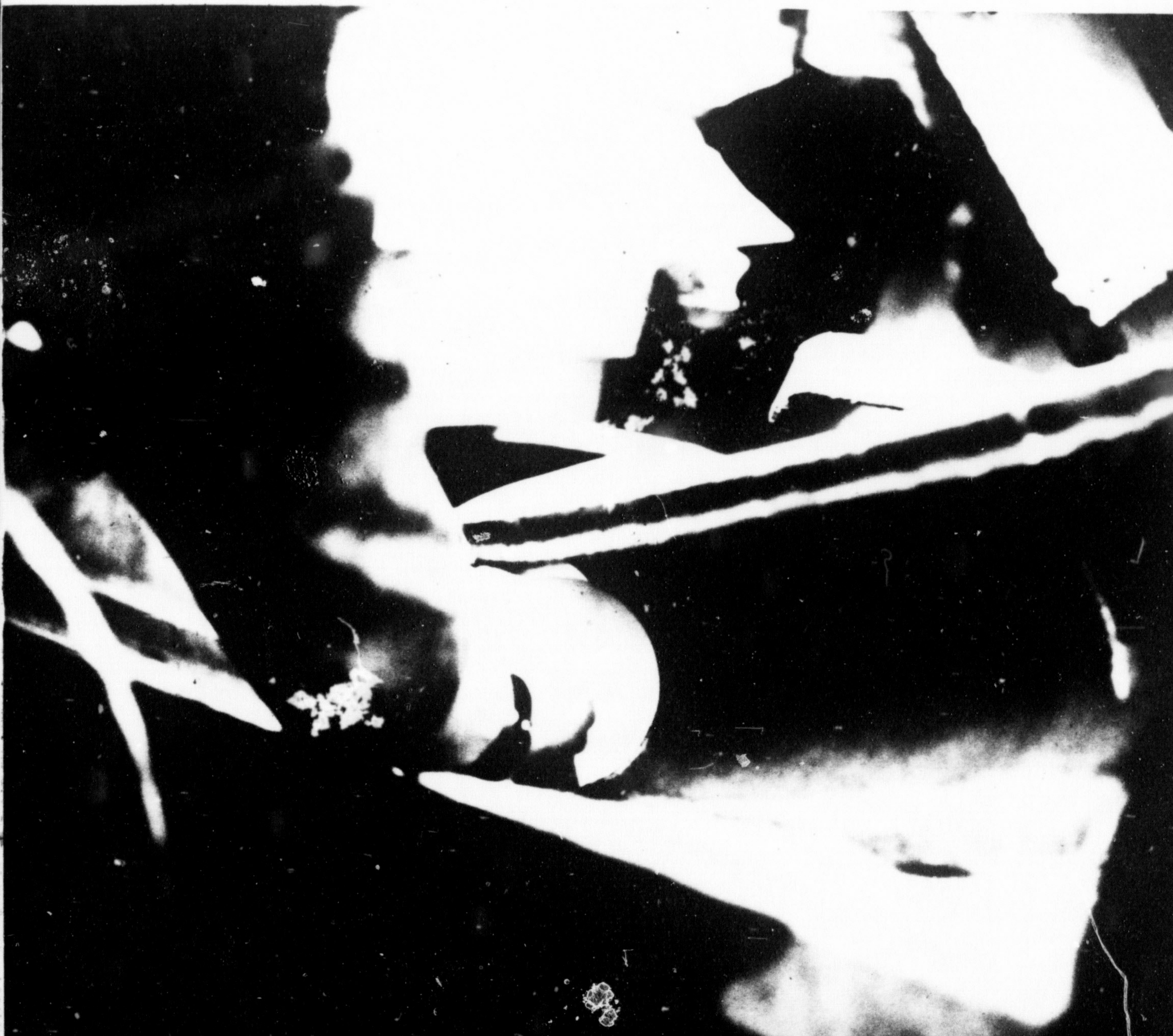


Crippen Supp. Aff.
Exhibit 1

EXHIBIT 2



Crippen Supp. Afft.
Exhibit 2
(First view)



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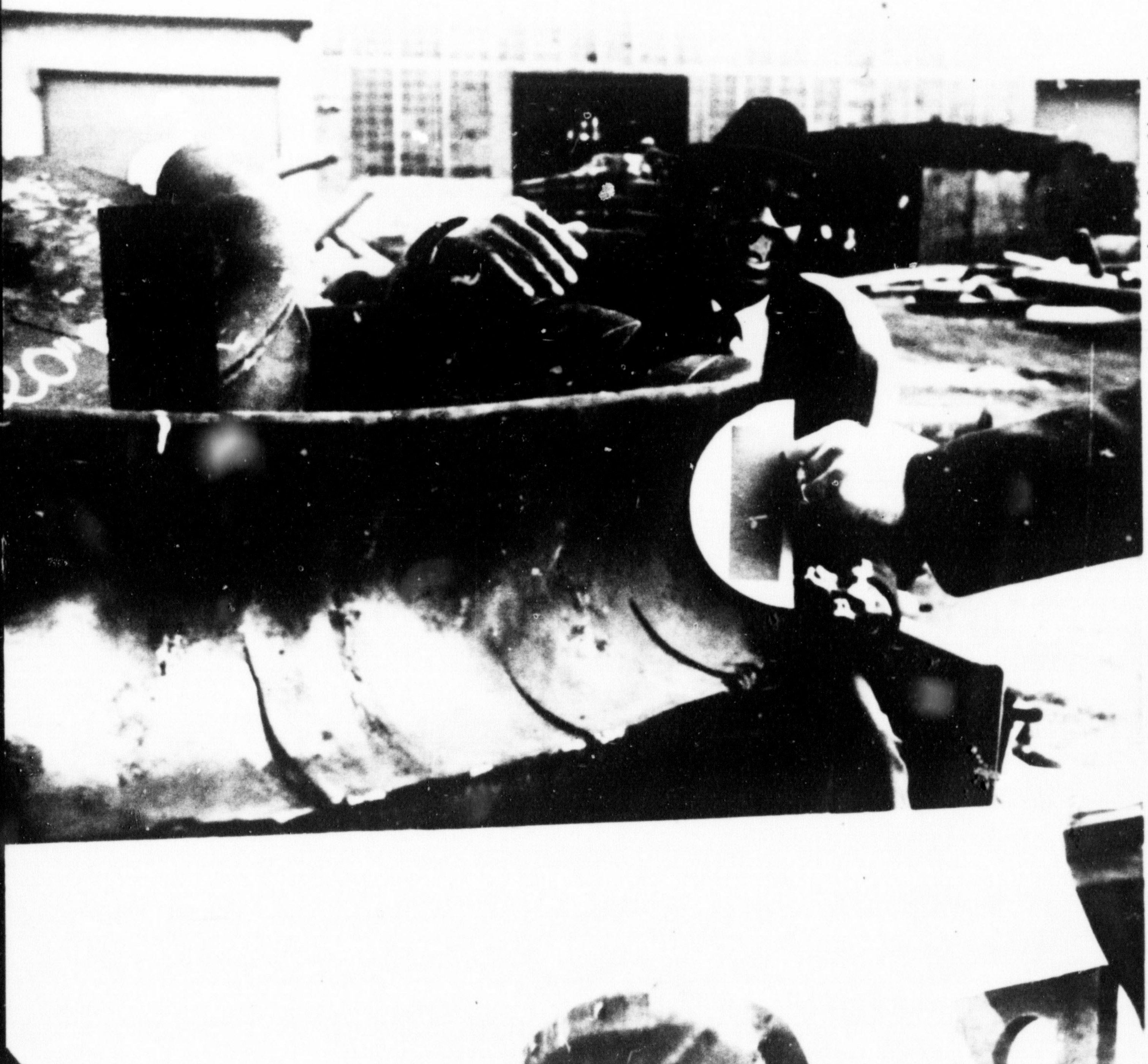
Crippen Supp. Afft.
Exhibit 2
(Second view)

EXHIBIT 3



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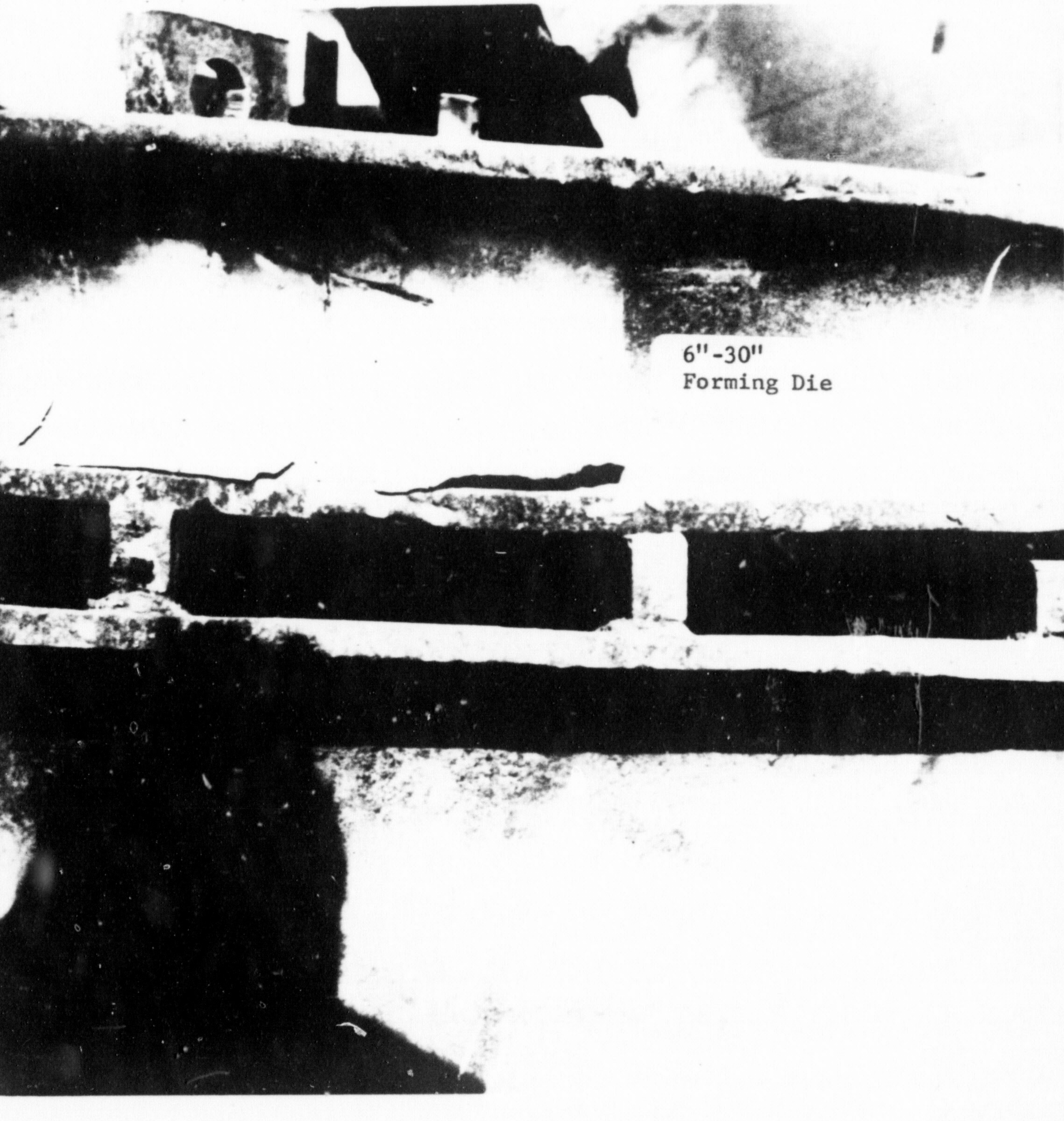
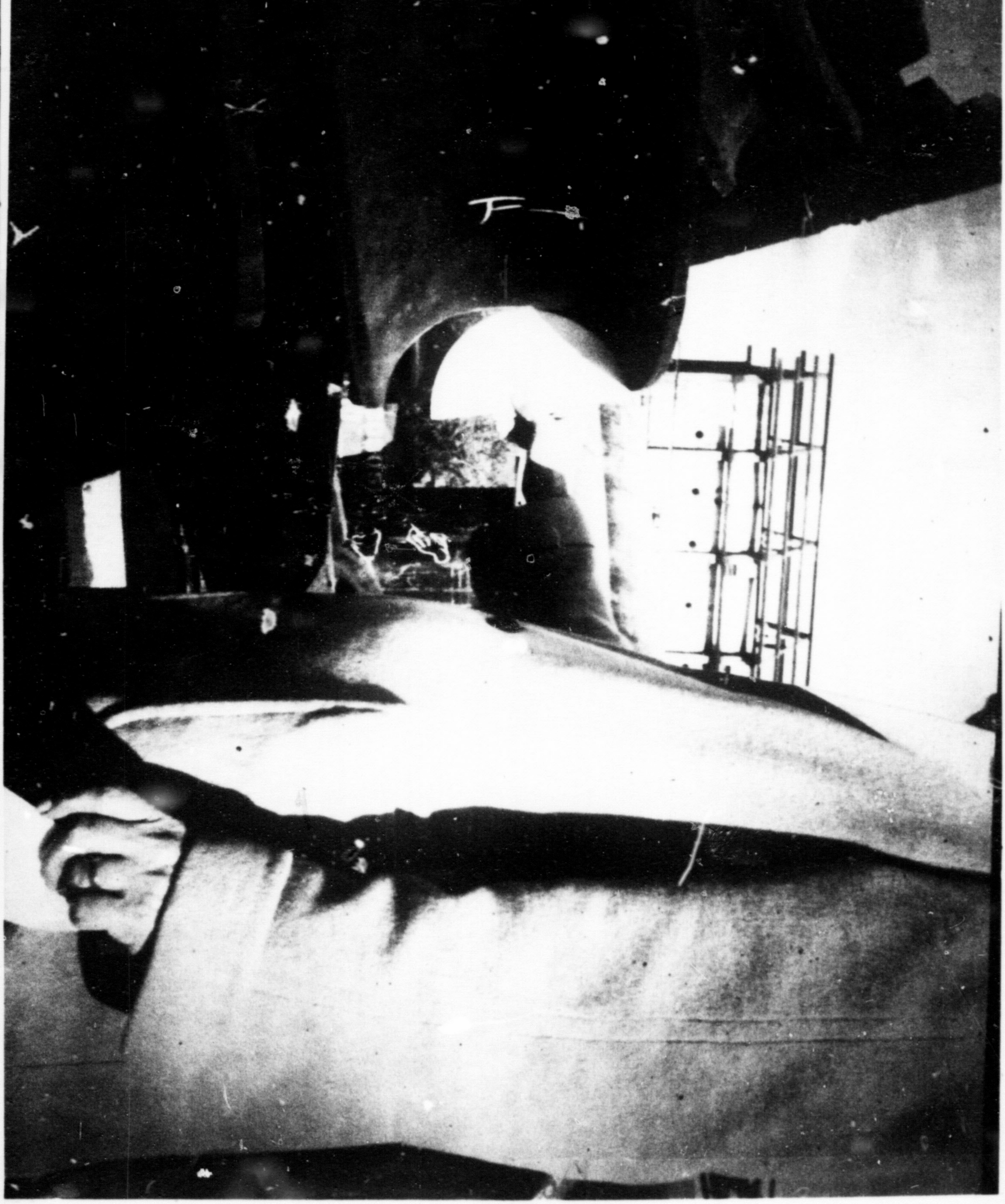
Crippen Supp. Afft.
Exhibit 3
(First view)


6"-30"
Forming Die

Crippen Supp. Afft.
Exhibit 3
(Second view)

EXHIBIT 4



500

Crippen Supp. Afft.
Exhibit 4

EXHIBIT 5

Crippen Supp. Aff.
Exhibit 5

EXHIBIT 6

Crippen Supp. Afft.
Exhibit 6

EXHIBIT 7

Crippen Supp. Afft
Exhibit 7

4"-20" SIZE FORMING DIE	(1) POSITION OF MEASUREMENT ON RADIUS OF BEND (Approximate one foot intervals)	(2) DIAMETER FROM TOP LIP TO BOTTOM LIP (inches)	(3) RADIUS (MAXIMUM) FROM A PLANE CONNECTING TOP AND BOTTOM LIPS TO THROAT OF CURVATURE FACE (inches)	(4) CIRCUMFERENTIAL LENGTH OF CURVATURE FACE ($\frac{C}{2}$) (inches)	(5) ESTIMATED (MAXIMUM) CIRCUMFERENTIAL DEGREES DIE IS IN CONTACT WITH SURFACE OF STANDARD WALL 4" PIPE (O.D.=4.5)
Dimensions For A 4-20 Forming Die Having A True 180° Curvature Face		4 1/2	2 1/4	$\frac{C}{2} = \pi r$ $= (3.1416)(2.25)$ $= 7.07$	180°
Measured Dimensions:	0	4 3/4	3 3/32		137°
	1	4 5/8	2 5/16		155°
	2	5	2 1/2		125°
	3	5	- **		125°
	4	- **	- **		-

* Although nominally designated a 4" pipe according to industry practice, the outside diameter is 4 1/2" for pipe of standard wall thickness.

** Distances impossible to measure due to position of die in pile.

<u>OBSERVATIONS</u>: This die contained inner liner welded to die face that did not extend to extremeties of die ends; die badly distorted; warped at ends; top and bottom lips not terminate in a vertical plane in much of the die. (see photographs) Die heavily rusted; web plate attachments broken and torn; edges of curvature face jagged, uneven.

EXHIBIT 8

Crippen Supp. Afft
Exhibit 8

6"-30" SIZE FORMING DIE	(1) POSITION OF MEASUREMENT ON RADIUS OF BEND (Approximate one foot intervals)	(2) DIAMETER FROM TOP LIP TO BOTTOM LIP (inches)	(3) RADIUS (MAXIMUM) FROM A PLANE CONNECTING TOP AND BOTTOM LIPS TO THROAT OF CURVATURE FACE (inches)	(4) CIRCUMFERENTIAL LENGTH OF CURVATURE FACE ($\frac{C}{2}$) (inches)	(5) ESTIMATED (MAXIMUM) CIRCUMFERENTIAL DEGREES DIE IS IN CONTACT WITH SURFACE OF STANDARD WALL 6" PIPE (O.D.=6 5/8"*)
Dimensions For A 6-30 Forming Die Having A True 180° Curvature Face		6 5/8	3 5/16	$\frac{C}{2} = \pi r$ $= (3.1416)(3.312)$ $= 10.4$	180°
Measured Dimensions:	1**	6 5/8	2 9/16	9	152°
	2	6 3/4	3	9 1/2	170°
	3	7	3 1/4	10 1/4	145°
	4	7	3 3/8	10 1/4	145°
	5	7	3 1/8	9 7/8	145°

* Although nominally designated a 6" pipe according to industry practice, the outside diameter is 6 5/8" for pipe of standard wall thickness.

** Measurement started approximately 6" from one end of die.

OBSERVATIONS: Approximately 3/4 of curvature face covered with sections of metal sheath, some of which was loose and sprung away from curvature face—sheath not continuously cover the die, leaving ridges and depressions. Die face covered with rust.

EXHIBIT 9

Crippen Supp. Aff't. Exhibit 9

8" - 32" SIZE FORMING DIE	(1) POSITION OF MEASUREMENT ON RADIUS OF BEND (Approximate one foot intervals)	(2) DIAMETER FROM TOP LIP TO BOTTOM LIP (inches)	(3) RADIUS (MAXIMUM) FROM A PLANE CONNECTING TOP AND BOTTOM LIPS TO THROAT OF CURVATURE FACE (inches)	(4) CIRCUMFERENTIAL LENGTH OF CURVATURE FACE ($\frac{C}{2}$) (inches)	(5) ESTIMATED (MAXIMUM) CIRCUMFERENTIAL DEGREES DIE IS IN CONTACT WITH SURFACE OF STANDARD WALL 8" PIPE (O.D.= 8 5/8"*)
Dimensions For A 8-32 Forming Die Having A True 180° Curvature Face		8 5/8	4 5/16	$\frac{C}{2} = \pi r$ $= (3.1416)(4.312)$ $= 13.5$	180°
Measured Dimensions:	0**	9 3/4	4 5/16	13 7/8	90°
	1***	10 1/2	3 15/16	14 1/8	72°
	2	10 3/4	3 3/4	14 1/4	60°
	3	10 3/4	3 3/4	14 1/4	60°
	4	10 3/4	4 1/8	14 3/8	60°
	5	10 3/8	3 7/8	14 3/4	75°

* Although nominally designated an 8" pipe according to industry practice, the outside diameter is 8 5/8" for pipe of standard wall thickness.
** Measured at one end of die.
*** This position approximately 5 inches from 0 position.

OBSERVATIONS: Entire die covered with rust; top and bottom lips uneven and jagged; noticeable waviness on portions of upper surface of curvature face.

EXHIBIT 10

16"-80" SIZE FORMING DIE	(1) POSITION OF MEASUREMENT ON RADIUS OF BEND (Approximate one foot intervals)	(2) DIAMETER FROM TOP LIP TO BOTTOM LIP (inches)	(3) RADIUS (MAXIMUM) FROM A PLANE CONNECTING TOP AND BOTTOM LIPS TO THROAT OF CURVATURE FACE (inches)	(4) CIRCUMFERENTIAL LENGTH OF CURVATURE FACE ($\frac{C}{2}$) (inches)	(5) ESTIMATED (MAXIMUM) CIRCUMFERENTIAL DEGREES DIE IS IN CONTACT WITH SURFACE OF STANDARD WALL 16" PIPE (O.D.= 16")
Dimensions For A 16-80 Forming Die having A True 180° Curvature Face		16.0	8.0	$\frac{C}{2} = \pi r$ $= (3.1416)(8)$ $= 25.13$	180°
Measured Dimensions:	0*	18 1/4	7 1/4		55-60°
	1	18 1/4	7 1/8	25 1/4	55-60°
	2	18 1/4	7 3/16		55-60°
	3	18 1/4	7 1/4		55-60°
	4	18 1/8	7 1/4		55-60°
	5	18 1/8	7 3/16	25 1/4	55-60°
	6	18	7 1/4		55-60°
	7	18	7 1/8	25 1/4	55-60°
	8	17 3/4	6 5/8		55-60°

* Measurement started approximately at one end of die.

OBSERVATIONS: Die caked with layers of rust.

Crippen Supp. Afft.
Exhibit 10

EXHIBIT 11

16"-96" SIZE FORMING DIE	(1) POSITION OF MEASUREMENT ON RADIUS OF BEND (Approximate one foot intervals)	(2) DIAMETER FROM TOP LIP TO BOTTOM LIP (inches)	(3) RADIUS (MAXIMUM) FROM A PLANE CONNECTING TOP AND BOTTOM LIPS TO THROAT OF CURVATURE FACE (inches)	(4) CIRCUMFERENTIAL LENGTH OF CURVATURE FACE ($\frac{C}{2}$) (inches)	(5) ESTIMATED (MAXIMUM) CIRCUMFERENTIAL DEGREES DIE IS IN CONTACT WITH SURFACE OF STANDARD WALL 16" PIPE (O.D.= 16.0")
Dimensions For A 16-96 Forming Die Having A True 180° Curvature Face		16.0	8.0	$\frac{C}{2} = \pi r$ $= (3.1416)(8)$ $= 25.13$	180°
Measured Dimensions:	1*	17 1/16	6 3/4		85°
	2	17 3/4	6 1/2		75-85°
	3	18	6 13/16	25.0	75-85°
	4	18 1/8	7		75°
	5	18	7		75-85°
	6	17 3/4	6 15/16	25.0	75-85°
	7	17 1/2	7 3/32		75-85°
	8	17 1/4	7 1/8		75-85°
	9	16 5/8	7 1/32	25.0	120°
	9.5	16 1/2	7 5/16		120°

* Measurement started approximately one foot from one end of die.

<u>OBSERVATIONS</u>: Top and Bottom lips uneven and ragged; entire die covered with rust.

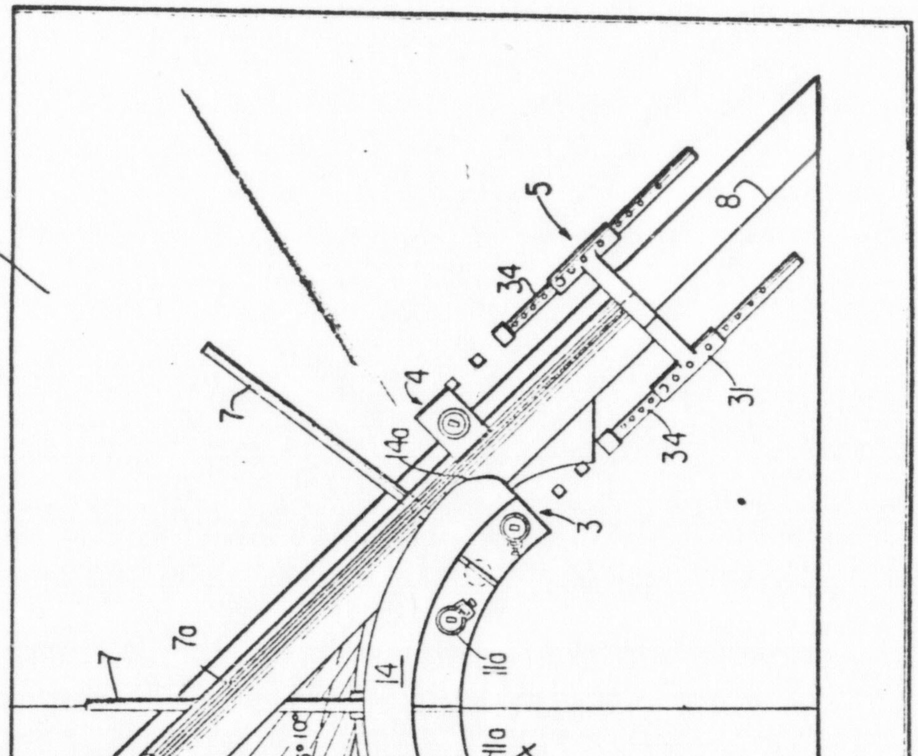
EXHIBIT 12

July 22, 1969 H. O. CRIPPEN 3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet 1

FIG. 1



INVENTOR
HENRY O. CRIPPEN
BY
Hammond and Littell
ATTORNEYS

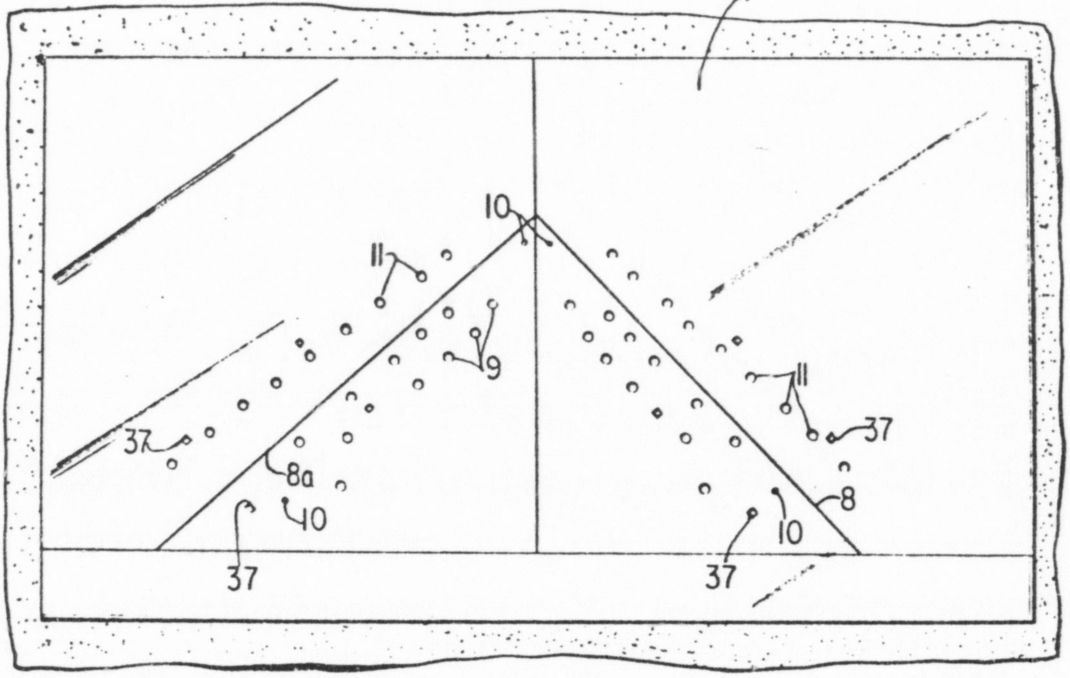
Crippen Supp. Afft.
Exhibit 12

July 22, 1969 H. O. CRIPPEN 3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet 2

FIG. 2



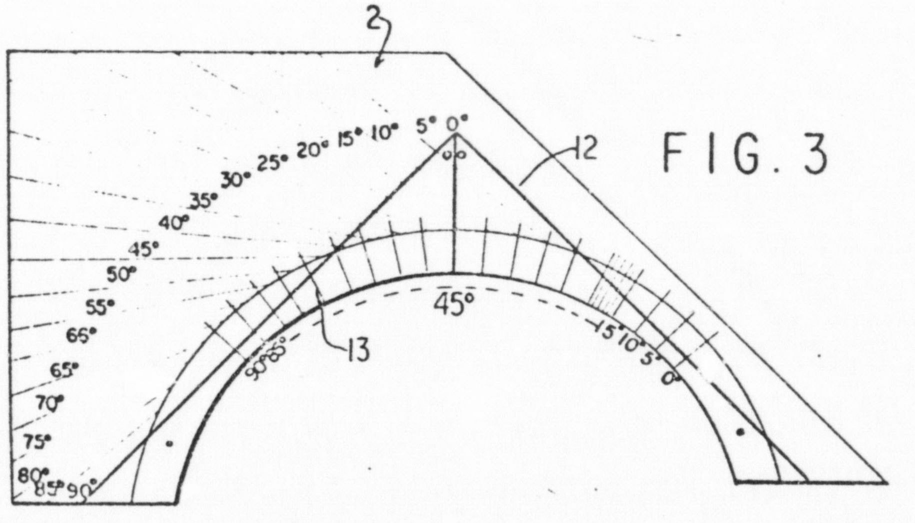


FIG. 3

INVENTOR
HENRY O CRIPPEN
BY
Harvard and Lettell
ATTORNEYS

HOT PIPE BENDING APPARATUS AND METHOD

Filed March 28, 1967 5 Sheets-Sheet 3

FIG.5

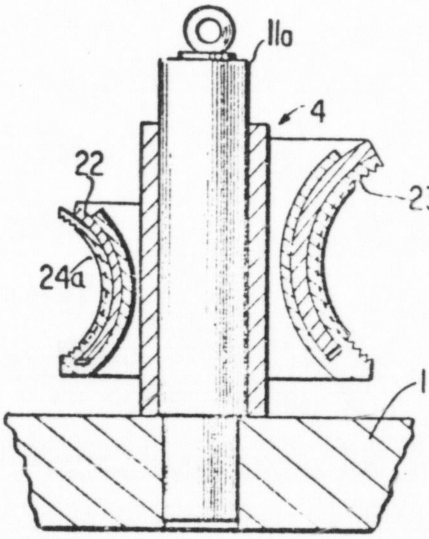


FIG.6

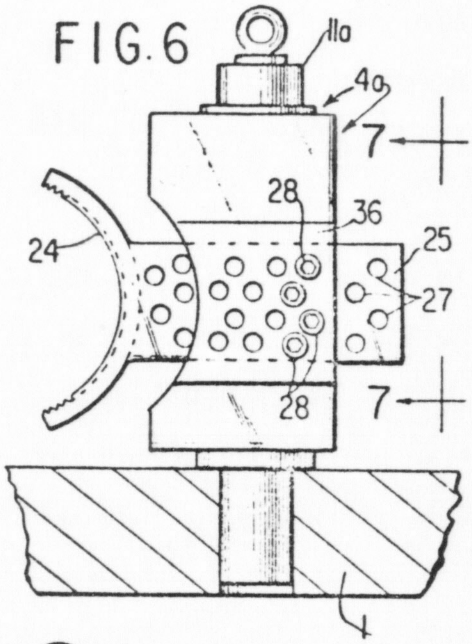
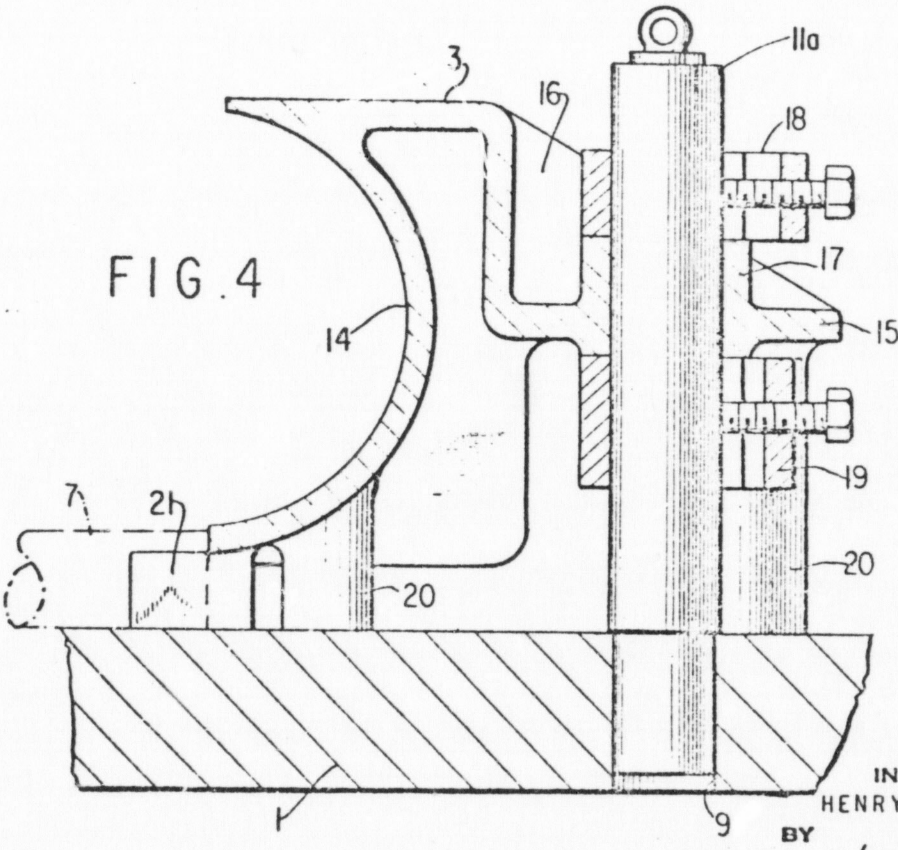
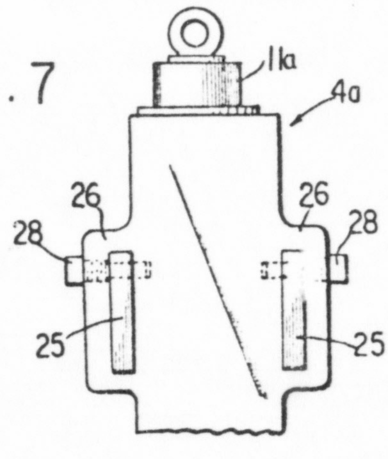


FIG.4



INVENTOR
HENRY O. CRIPPEN
BY
Hammond & Littell
ATTORNEYS

FIG. 7



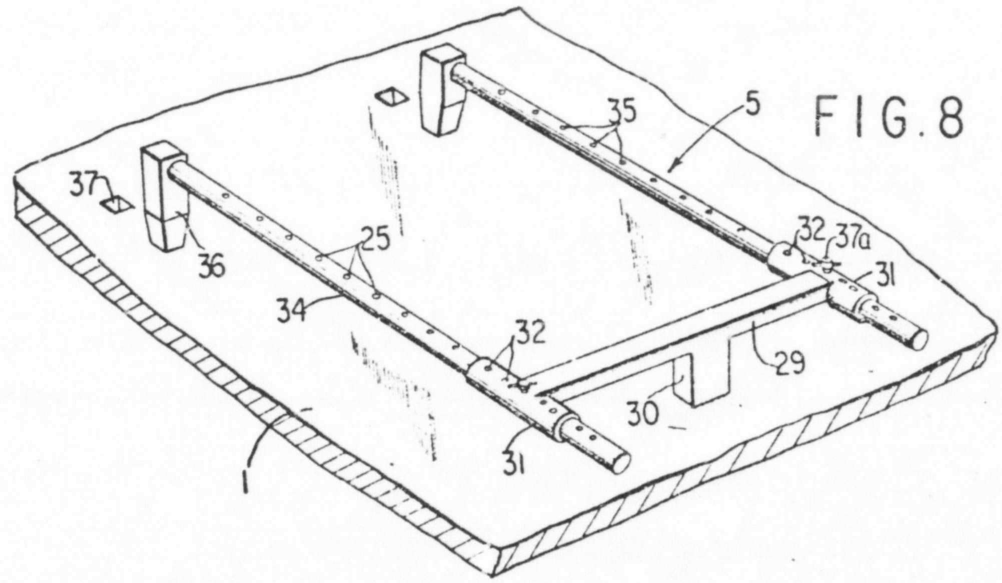
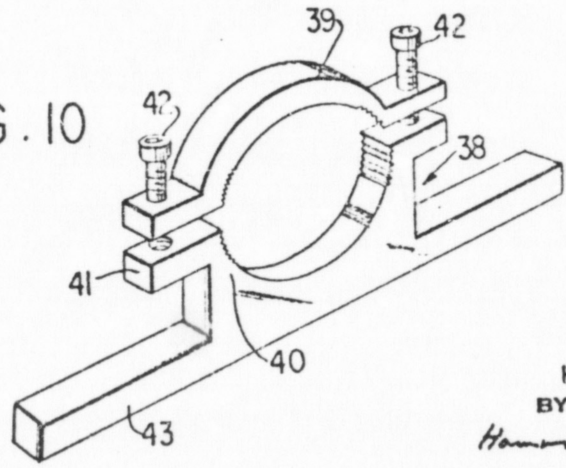


FIG. 8

FIG. 10



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HOT PIPE BENDING APPARATUS AND METHOD

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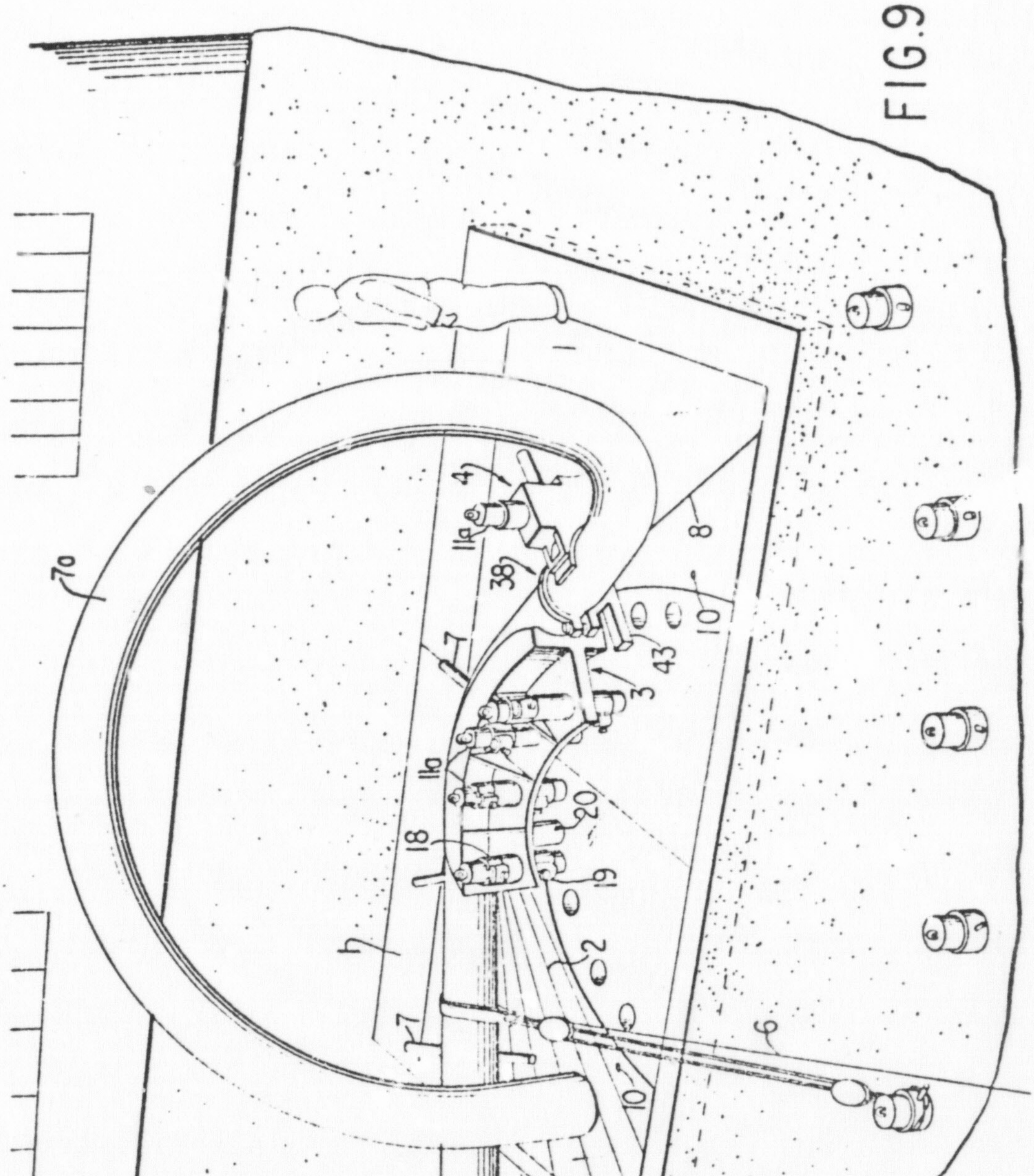
FIG.9



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United States Patent Office

3,456,468

Patented July 22, 1969

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3,456,468

HOT PIPE BENDING APPARATUS AND METHOD

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Filed Mar. 28, 1967, Ser. No. 626,458
Int. Cl. B21d 9/05
U.S. Cl. 72—34 12 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for heat-bending large diameter pipe comprised of a bending block provided with guidelines forming a 90° angle, base template protractor, arced forming dies with about 180° grooved curvature face and having varying radii, means for holding one end of the pipe against the forming die during bending, means for maintaining the pipe level within the curvature face and means for applying pressure to bend the hot pipe about the die and a method of bending a hot pipe rapidly with a minimum of secondary operations and butt welding.

Prior art

Large diameter pipes are used in construction of many plants and buildings and for many installations they must be bent in specific ways in order to fit into the design conditions. Present methods of bending large diameter pipe have been costly due to the number of skilled men and the time required in the bending operation, the inaccuracy of the present system which results in waste of pipe or requires subsequent treatment by skilled personnel, and the difficulty in obtaining compound bends in a pipe. In the most common pipe-bending operations being used today, the pipe, which is filled with sand, is heated to a high temperature, i.e., 1500 to 2000° F., in a furnace and then set up on the bending table, which has a variety of holes therein. The starting end of the pipe is securely fastened and the portion of the pipe to be bent is without control of the angle of the bend and this portion rides free, resting on the bending table. The angle of the bend is controlled by the skill of the bender, by the use of a template, water and movement of the holding attachments and the angle of pulling leverage. The bending pressure is applied by a capstan with the use of several pulleys and a rope. The pulleys are held by stanchions. The rope is passed around the pulleys and connected to the pipe to be bent and the rope is then wrapped several times around the capstan. The bending pressure is started by tightening the rope around the revolving capstan and the bending pressure is relieved by releasing the rope. This operation is repeated until the desired angle of bend in the pipe is attained. During the operation of the bending, two men hold a template (usually a heavy wire bent to the desired angle of the bend) over the pipe to make certain the correct angle and radius of bend is obtained.

In addition to the men holding the template, a capstan operator and a man with a water hose are required. Water spraying of the hot pipe has two primary purposes: (1) to affect the radius of the pipe when the bend is closing in too sharply by spraying water on the outer side of the pipe to chill this portion of the pipe and stop or slow the bending in that portion, and (2) to prevent buckles in the pipe caused by the throat being too hot by spraying the inner side of the pipe with water. This operation requires not only four men and a great deal of time, but also a high degree of skill and experience. In addition, only clockwise or counterclockwise bends may be made on existing apparatus.

The said procedure has many disadvantages. One disadvantage resides in the amount of time required to perform the bend, since the pipe cools rapidly and more

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pressure is required to bend the pipe the more it cools. For example, the tensile strength of one common pipe metal at 1600° F. is 10,000 pounds per square inch, while at a temperature of 1250° F., the same metal has a tensile strength of 35,000 pounds per square inch, an increase of 3.5 times in tensile strength over a temperatue drop of only 350° F. Under normal plant conditons, metal pipes will cool approximately 100° F. per minute and, therefore, the tensile strength of pipes and the pressure necessary to bend the pipes increases rapidly. If the pipe becomes too cold during the bending operation, too much pressure is required and flattening of the pipe walls occurs. Moreover, sharp or abrupt pulls on the pipe during bending thereof will cause thinning in the pipe walls which weakens the pipe. Faults caused by overbending, underbending, buckling, flattening or the like cause a high amount of rejects which increases the cost of pipe bending operations.

For proper bending, the outer side or heel of the pipe should be hotter, since the heel has to stretch and the inner side or throat of the bend only has to compress. When water is used to cool the inner side of the pipe, it will frequently cool one section of the throat of the pipe too much, which section becomes harder than the surrounding pipe sections and causes buckle. Thinning will occur due to uneven stretching and/or compression. If the throat of the pipe is unevenly cooled, the hotter portions of the throat will compress faster and cause buckles. If the far end of the pipe remains hotter than the portion of the pipe being controlled by the water, the pipe will bend farther ahead of the portion to be bent instead of following gradually the desired radius and the bend will not have the proper arc or radius.

Objects of the invention

It is an object of the invention to provide a novel apparatus for accurately and rapidly bending large diameter pipe with small crews.

It is another object of the invention to provide a novel apparatus for bending large diameter pipe without the use of water for cooling.

It is a further object of the invention to provide a novel pipe bending apparatus which may be used for different size pipes to obtain bends up to 360° with varying radii and to obtain accurate compound bends in pipe.

It is another object of the invention to provide a pipe bending apparatus in which large diameter pipes may be bent clockwise or counterclockwise.

These and other objects and advantages of the invention will become obvious from the following detailed description.

The apparatus of the invention for bending large diameter pipes is comprised of a bending block provided with two guide lines forming a 90° angle and preferably provided with a plurality of holes therein; a base template protractor resting on the bending block marked off in degrees from 0 to 90° with the 0° line coinciding with one of the guide lines on the bending block and the 90° line coinciding with the other guide line on the bending block, an arced forming die, preferably having slightly more than a 90° arc, with a 180° grooved curvature face and have a radius substantially equal to the radius of the desired pipe bend, the said die being securely centered on the bending block so that the bottom lip of the forming die curvature at each end at 90° of this curvature face meets a guide line on the base template protractor at tangential points on the base template protractor, means for holding one end of the pipe to be bent against the forming die when laid along either guide line on the base template protractor, means for keeping

the pipe level during the bending operations, and pressure applying means to bend the pipe about the die the desired number of degrees.

The bending block is a rectangular steel block which is preferably made in two pieces for handling ease during construction thereof. The said block acts as a table upon which the hot pipe is bent and is set in the floor of the bending plant and is preferably level with the plant floor. On each side of the bending block at specified distances therefrom, holes are provided in the floor of the bending plant which accommodates stanchions which can be raised or lowered to provide for the positioning of the pressure applying means at a height so that the pipe is bent in a plane parallel to the floor. The angle of the applied pressure may be varied and clockwise and counterclockwise bends may be made by the proper selection of the stanchion.

The bending block is provided with two guide lines thereon which form a true 90° angle and these two guide lines provide a reference point layout for the bending block holes and for all of the equipment that fits thereon. Preferably, the bending block has a plurality of holes arranged along the two guide lines whereby forming dies may be secured with dowel pins passing down through dowel pin sleeves provided on the form plate of the forming die and engaging the holes in the bending block. The dowel pins in the holes secure each forming die in the proper relationship to the guide lines on the base template protractor. In a preferred embodiment, the bending block has 38 of the said holes positioned with respect to the angle formed by the guide lines to accept various sized forming dies for bending pipes of 6" to 18" diameter and the holding shoes. For bending of larger diameter pipes, i.e., up to 24" diameter, additional holes may be provided.

The holes in the bending block are arranged so that the center of the hot pipe, when it is in the forming die at the start of the bending operation, lies along one of the two guide lines. The forming die must be held securely in position on the bending block so that there is no movement thereof during the bending operation. The dowel pins and holes in the bending block provide the simplest method of securing the forming die without complicated attachments. For ease of handling, the dowel pins holding the forming die may be provided with eyehooks so that they may be removed from the holes in a simple fashion.

The base template protractor is secured on the bending block and fits around the base of the forming die. The said protractor is provided with degree lines from 0° to 90° at right angles to the radius of the forming die so that constant observation of the degree of the bend may be made during the entire bending process. The 0° line coincides with one guide line on the bending block upon which the hot pipe is laid at the start of the bending operation and the 90° line coincides with the other guide line. A second scale is preferably provided on the base plate protractor along the base of the curvature face of the forming die and coinciding with the center line of the pipe being bent and extends slightly beyond the outside diameter guide line. The 0° mark indicates the start of the bend in the pipe and the scale indicates the circular degree of the bend so that the exact position of the end of a bend can be marked on the pipe and a second bending operation may be effected, if necessary. The degree of the bend arc is the tangential point where the unbent portion of the pipe meets the forming die.

The base template protractor may also be provided with a concentrical guide line about the second scale which lies just outside the diameter of the bent pipe in the forming die. This line serves for checking the outside diameter of circular bends while they are still on the bending block. Preferably, the base template protractor is provided with scales on both sides so that it has two faces, one face used for clockwise bending and the other face used for counterclockwise bending, depending upon its position on the bending block. A base template protractor is provided for each die to be used and each base template protractor coincides exactly with the two guide lines on the bending block whether it is used for clockwise or counterclockwise bending.

To secure the base template protractor in position, the bending block and the said protractor may be provided with cooperating holes so that dowel pins can pass through the template into the bending block. The said protractor provides a means for constantly observing the degree of the pipe bend from the start of the bend to the finished angle.

The forming die is an important feature of the invention since it provides a form about which the hot pipes can be bent without buckles or wrinkles or flattening or thinning of the pipe walls. The forming die is comprised of a die body having a grooved curvature face with a peripheral arc of 180° and a diameter slightly larger than the diameter of the pipe to be bent, a form plate centered along the entire back of the die body provided with sleeves to accommodate dowel pins which pass therethrough and engage holes in the bending block. Gussets between the back of the die body and the form plate may be provided for further strengthening of the die body. When the forming die is in position on the bending block, the bottom lip of the curvature face fits concentrically with the second scale of the base template protractor. Preferably, the ends of the top lip of the curvature face are elliptically shaped so that the hot pipe to be bent may be easily inserted into the forming die along the guide line and clamped into position rapidly.

The length of the die curvature for bending 18" diameter pipe is approximately 100 degrees in circumference. The dies for bending up through 18 inch diameter pipes may be varied from 100 degrees up to 180 degrees in circumference. The center of the forming die, when it is in position, should coincide with the middle of the 90° angle formed by the two guide lines on the bending block.

The curvature face of the forming die should be slightly elevated from the bending block so that the hot pipe in the bending position is slightly elevated to allow the pressure applying means to be attached to the hot pipe while keeping the hot pipe in a level plane. The curvature face and the form plate may, therefore, be provided with pedestals for their support. To support the hot pipe during the bending operations, a plurality of riding pipes or other means of the same height as the inside bottom lip of the curvature face are provided to keep the neutral axis of the pipe parallel to the neutral axis of the forming die. The riding pipes may be accommodated in recesses under the bottom lip of the curvature face and radiate from the curvature face.

The sleeves of the form plate of the die body are slightly larger in diameter than the dowel pins which engage the holes in the bending block. To take up the play between the said sleeves and the dowel pins, shims may be used. However, it is preferred to provide the sleeves at the top and bottom thereof with adjustable collars which can be hand tightened about the dowel pins to prevent movement of the die when bending pressure is applied to the pipe.

Means are necessary to hold one end of the hot pipe to be bent against the forming die in order to sustain the back pressure occurring when the hot pipe is pulled about the forming die to affect bending of the pipe. One suitable holding means when bending pipes up to 90° is a holding shoe having at least one curvature, preferably two, curvature faces on opposite sides, which are peripherally sufficient to support the outer side of the pipe. The said curvature faces may have a peripheral arc of approximately 90° and are offset from each other so that one curvature face will normally be in position to hold 6" diameter pipe and the other curvature face will

normally be in position to hold 12" diameter pipe. To hold different size pipes, the height of the neutral axis of the curvature face can be raised by spacer rings under the holding shoe so that the axis of the curvature face will lie in the same plane as the neutral axes of the forming die and the pipe. By this means, one curvature face can be used to hold pipes having 6" to 12" diameters and the other curvature face can be used to hold pipes having 12" to 18" diameters.

The holding shoe may be held in position by a dowel pin passing through the body of the holding shoe and engaging a hole in the bending block. This arrangement allows the holding shoe to be pivoted about the dowel pin so that the curvature face may be turned aside to allow more room for insertion or removal of the pipe from the forming dies. The holding shoe is positioned so that the pipe of a specific diameter is securely held in the forming die for that diameter. If odd size pipe is to be bent, i.e., a 9" diameter pipe in a 10" diameter forming die, the curvature face of the holding shoe may be provided with a correspondingly shaped shim insert to compensate for this difference in diameter.

While the said holding shoe is completely adequate for bends up to 90° in a pipe, difficulties arise with this shoe when bends of more than 90° are being made since the bent portion of the pipe to be held after the initial bend does not lie along the 0° guide line of the primary scale of the base template protracter but is concentrically aligned with the extended outside diameter guide line on the base template protractor. For this type of bending another holding shoe having a laterally adjustable curvature face is used.

This latter modification of holding shoe is provided with an adjustable extension arm on each side of the holding shoe which supports the curvature face whereby the curvature face can be moved laterally towards the pipe so that the pipe is held in conformity with the extended outside diameter guide line on the base template protractor. The neutral axis of the curvature face is offset from the middle of the holding shoe body so that the curvature face will be in position for holding 6" diameter pipe and when the holding shoe is inverted the curvature face will be in position for holding 12" diameter pipe. The said holding shoe may be raised with spacer rings for holding larger size pipes as with the previously described holding shoe.

The extension arms are preferably provided with 36 holes and the holding shoe is preferably provided with 12 holes on each side. The said holes are arranged so that 4 holes on each extension arm will coincide with 4 holes on each side of the holding shoe in varying positions so that 4 pins may be inserted through each side of the extension arm and the holding shoe to firmly hold the curvature face in the final position.

In a preferred embodiment of the apparatus, an adjustable stop means is provided for proper positioning of pipes when they are placed in the forming die for bending up to 90°. This stop means may be an adjustable stand rack with a stop-bar which acts as a backstop called a chock set. The stop-bar of the chock set may be slidably moveable along two channel tubes to provide for a plurality of bend tangents and is capable of being securely affixed thereto in any desired position. The forward ends of the channel tubes may be attached to square pegs which fit into square holes in the bending block to hold the chock set in position. The position of the stop-bar is preadjusted to stop the end of the pipe to be bent at the computed tangent dimensions so that the heated pipe will be aligned in the proper position for the start of the bend when inserted in the apparatus with its end abutting against the stop-bar.

In order to hold the pipe properly in position when making compound bends or second bends in circular bends, a position clamp is provided to prevent rotation of the pipe during the compound bending process, or to hold the pipe during the second bend of circular bends since the chock set is not used for these bends. This clamp may be made of two semi-circular parts which form a circular collar. Both circular parts are preferably provided with jagged teeth to clamp onto the pipe when the two parts are fastened together. The bottom semi-circular collar is provided with a base to prevent turning of both the pipe and clamp during the bending process. After the initial bend is put in the pipe, which is to have a compound bend put therein, the pipe is then put in the desired position in the forming die for the next portion of the bend. The position clamp is then placed about the pipe and firmly clamped thereto. The pipe may then be heated with the position clamp attached and re-inserted into the forming die so that the pipe can be rapidly aligned and no time for adjustment of the pipe is lost once the pipe is heated for the second portion of the compound bend. The height of the base of the position clamp should be such that the bottom semi-circular collar lies in the same plane as the inner bottom lip of the curvature face of the forming die so that the neutral axis of the pipe will be in the same plane as the neutral axis of the forming die curvature face.

The pipe bending apparatus of the invention has a wide variety of advantages, the most important of which are accurate rapid bending of pipes, whether simple, circular or compound bends or clockwise or counterclockwise or both, with a minimum of skill and number of men and equipment. The bending block provides a base for a large variety of setups for different bends. The base template protractor provides a simple means of constant observation of the angle of bend of the pipe.

The forming die due to its deep segmental curvature face provides a constant, protective support to the pipe along the entire portion of the pipe being bent thereby providing synchronization of the gradual stretching of the heel of the pipe and the compressing of the throat for proper following of the radius of the forming die. This prevents sharp abrupt pulls or bends and prevents thinning of the wall of the pipe. Since the pipe is never deviated from its bending course with the use of the forming die, the use of water on the pipe during bending is completely avoided and the disadvantages which occur with the use of water do not occur in the bending process. The forming die also extracts heat from the throat of the pipe and renders the inner side of the pipe cooler during the bending, which prevents the pipe from compressing too fast on its concave face. This coolness of the throat gives additional strength or stiffness, enabling it to resist creasing caused by the pressures put on it by the pull of the bend. This is advantageous since the heel or outer side of the pipe should be hotter during bending as it has a farther distance to travel and stretch while the throat has only to compress.

Another advantage of the apparatus of the invention is that bending may be done rapidly and little time is lost in positioning the pipe. This is important since pipes must be bent while hot and the longer the time between removal from the furnace and the completion of the bend, the more difficulties arise. The apparatus provides for an even bending pressure and the pipe follows the continued arc of the forming die which prevents the pipe from being bent sharply and prevents disruption of the compressing and stretching of the throat and heel of the bend. This lessens the chance of buckles that occur with the known methods of bending.

Referring now to the drawings:

FIG. 1 is a plan view of the pipe bending apparatus of the invention with the pipe in position for the start of the counterclockwise bend.

FIGS. 2 and 3 are plan views of the bending block and the base template protractor, respectively.

FIG. 4 is a cross-sectional view of the forming die of FIG. 1, taken along line 8—8.

FIG. 5 is a cross-sectional view of one holding shoe used to hold the pipe in position during bending.

FIG. 6 is a side view of an adjustable holding shoe used to hold the pipe in position when performing a bend of more than 90°.

FIG. 7 is a cross-sectional view of the holding shoe of FIG. 6, taken along line 7—7.

FIG. 8 is an enlarged view of the chock set of FIG. 1.

FIG. 9 is a view of another embodiment of the pipe bending apparatus of the invention during compound bending of a large diameter pipe.

FIG. 10 is an enlarged view of the position clamp of FIG. 1.

In the embodiment illustrated in FIG. 1, the pipe bending apparatus, ready to begin a bend, is comprised of bending block 1 set in the floor of the pipe bending shop, and provided with guide lines 8 and 8*a* which form a true 90° angle, approximately along the center line of the bending block, a base template protractor 2, forming die 3 centered on the 90° angle, holding shoe 4, chock set 5, block and tackle 6 attached to a winch (not shown), and riding pipes 7 which keep the pipe 7*a* level with the inner bottom lip of the forming die.

As can be seen from FIG. 2, the bending block 1 is provided with a series of holes 9 along guide lines 8 and 8*a* within the angle formed thereby which engage dowel pins 11*a* to secure forming dies for different diameter pipes to the bending block. The bending block is also provided with smaller holes 10 which engage pins to secure base template protractor 2 thereto and with holes 11 along guide lines 8 and 8*a* outside the angle formed thereby to engage dowel pins to secure the holding shoe 4 in various positions for different diameter pipes.

In FIG. 3, the base template protractor is shown as provided with two sets of degree markings from 0° to 90°. On the primary set 12 of degree markings, the 0° line coincides with guide line 8 of the bending block and the 90° line coincides with guide line 8*a* when the base template protractor is secured to the bending block. The degree lines of this scale radiate tangentially from the forming die so that the degree of the bend in the pipe can be easily observed throughout the bending. In the secondary set 13 of degrees, the 0° mark coincides with the portion of the forming die 3 at which the bend will start and runs radially to 90° with the 45° mark coinciding with the center of the 90° angle formed by guide lines 8 and 8*a*. The secondary scale 13 permits a bender to determine the radial degree at which a bend has stopped when bending more than 90°. The pipe 7*a* may then be marked where the bend stopped, be re-heated and reinserted into the die with the mark on the pipe aligned with the 0° mark of the secondary scale for the start of a second bend.

The forming die 3 as shown in FIG. 4 is comprised of a curvature face 4 ensuring that the heated portion of the pipe will be protected, form plate 15 secured to the back of curvature face 14 and gussets 16 which provide strength to the forming die. Form plate 15 is provided with sleeves 17 through which dowel pins 11*a* pass and engage holes 9 in bending block 1. The top and bottom of sleeves 17 are provided with adjustable collars 18 and 19 which firmly clamp the die body in position. The curvature face 14 and form plate 15 are provided with pedestals 20 to support the forming die, and to elevate the curvature face slightly above the surface of the bending block so that the block and tackle 6 may be attached to pipe 7*a* during the bending without changing the plane of the bend. The top of riding pipes 7 coincides with the inner bottom lip of curvature face 14 and is held in position by brackets 21. As shown in FIG. 1, the outer edges 14*a* of the upper lip of curvature face 14 are elliptically shaped so that pipe 7*a* may be positioned directly on guide line 8 without hitting the forming die curvature face.

FIG. 5 illustrates a holding shoe 4 which can be used to bend different diameter pipes from 6″ to 18″ and is provided with two curvature faces 22 and 23 which are provided with jagged teeth to firmly grip the pipe. The arc of the said curvature faces is approximately 90°. Curvature face 22 is positioned so that the bottom lip thereof is elevated above the bending block slightly higher than the riding pipes 7 so that it may be used to hold small diameter pipes, i.e. 6″ to 12″, while the curvature face 23 is more elevated above the bending block to hold larger diameter pipes, i.e., 12″ to 18″. The neutral axis of the forming die curvature face to be used is precisely in the same plane as the neutral axes of the pipe to be bent and the curvature face of the holding shoe. To accommodate odd size pipes, i.e., 9″ diameter, the curvature faces of the holding shoe may be provided with a shim 24*a* to take up the difference.

Holding shoe 4*a* of FIGS. 6 and 7 is especially useful for compound bending and in putting a second bend in a circular bend since the curvature face 24 can be moved laterally to engage the bent portion of the pipe which will not lie along guide line 8. The curvature face 24 is held on either side by extension arms 25 which slide in slots 26 of the holding shoe.

The extension arms 25 are provided with 4 rows of 9 holes, 27, while the body portion of the holding shoe is provided with 4 rows of 3 holes in each, which are arranged so that 4 holes in extension arms 25 will correspond with 4 holes in the body of the holding shoe, so that the distance between curvature face 24 and the holding shoe body can be varied in 1″ increments. The extension arms are held firmly in position by pins 28 which pass through the 4 aligned holes in the extension arms and the holding shoe body.

The chock set, shown in detail in FIG. 8, is used so that the portion of the pipe where the bend is to start will be aligned with the 0° mark on the secondary scale of the base template protractor when the end of the pipe 7*a* is abutting against the chock set 5. The chock set is comprised of a stop-bar 29 provided with a pedestal 30 in the center thereof and with tubular collar sleeves 31 at either end thereof, which sleeves have a plurality of holes 32 drilled therethrough. Passing through each of collar sleeves 31 is an extension channel tube 34 provided with a plurality of holes 35 drilled therethrough and with a square pin at the end thereof to hold the channel tubes parallel to the bending block at the same height as the stop-bar 29. The square pins 36 engage square holes 37 in the bending block in order to hold the chock set in position. The stop-bar 29 can be moved along the length of channel tubes 34 to the desired position and secured therein by passing pins 37*a* through the holes in the collar sleeves and in the channel tubes.

To bend a pipe, a forming die with a curvature face of the desired radius and diameter and its base template protractor are secured to the bending block with dowel pins 11*a*. Holding shoe 4 is positioned on bending block 1 with its curvature face turned aside from the forming die 3. To bend a pipe up to 90° with the apparatus of the invention, the length of the arc of the bend is marked off on the pipe 7*a* where the bend is to begin and to end. The die 3 and base template protractor 2 for this bend radius and diameter of pipe is positioned on the bending block 1 with the inner side of the base template protractor adjoining the bottom lip of the curvature face of the forming die and the holding shoe 4 is positioned in the proper hole in the bending block 1 for the diameter of the pipe 7*a*. The chock set 5 is preadjusted so that the butt of the pipe 7*a* will abut against stop-bar 29 with the beginning of the bend marked on the pipe 7*a* coinciding with the 0° mark on the secondary scale 13 of the base template protractor 2. The pipe 7*a* is then heated to the proper temperature in a furnace and brought to the bending apparatus. The pipe is laid along guide line 8 with its butt against the stop-bar 29 of chock set 5 and holding shoe 4 is turned so that its curvature face holds the pipe firmly against the forming die when bending

pressure is applied. The block and tackle 6 is attached to the end of the pipe 7a and the winch is started to bend the pipe about the curvature face of the forming die and the desired number of degrees.

Although FIG. 1 illustrates the bend as starting from the right side of the bending block, the holding shoe 4 and chock set 5 may be located at the left side of the bending block and the bend can be made from the left side to the right side of the bending block.

FIG. 9 illustrates the apparatus of the invention putting the third bend in a compound bend in a pipe 7a. The chock set is not used since the end of the pipe does not end along guide line 8. The portion of the pipe 7a where the bend is to begin is marked on the pipe and position clamp 38 is attached to the pipe to prevent the pipe from twisting or turning during bending.

As can be seen from FIG. 10, position clamp 38 is comprised of an upper semi-circular collar 39 and a lower semi-circular collar 40 provided with lugs 41 having threaded holes so that the two halves of the clamp can be securely held together by bolts 42. The inner surfaces of the semi-circular collars are preferably jagged to ensure firm gripping of the pipe. Bottom semi-circular collar 40 is provided with a base 43 extending out on either side thereof which prevents twisting of the position clamp and pipe during bending.

Various modifications of the apparatus and method of the invention may be made without departing from the spirit or scope thereof and it is to be understood that the invention is to be limited only as defined in the appended claims.

I claim:

1. An apparatus for hot bending large pipes of at least 6" diameter comprised of a bending block provided with two guide lines forming a 90° angle; base template protractors to rest on the bending block provided with a primary scale marked off in degrees from 0 to 90° with the 0° line coinciding with one of the guide lines on the bending block and the 90° line coinciding with the other guide line on the bending block and a secondary scale with a scale from 0° to 90°, arced forming dies having approximately 180° grooved curvature faces and a radius equal to the radius of the desired pipe bend, the said die being securely centered on the bending block within the 90° angle formed by the primary scale and with the bottom lip of the forming die curvature face coinciding with the secondary scale of the base template protractor, means for holding one end of the pipe to be bent against the forming die when laid along either guide line on the base template protractor, means for keeping the pipe level with the curvature face of the forming die and pressure applying means to bend the hot pipe about the die the desired number of degrees.

2. The apparatus of claim 1 wherein the bending block is provided with a plurality of holes which cooperate with dowel pins to secure the base template protractor, the forming die and the holding means in position.

3. The apparatus of claim 1 having an adjustable stop means against which the hot pipe abuts during bending whereby the portion of the pipe where the bend starts coincides with the 0° mark on the secondary scale of the base template protractor with the pipe abutting against the said stop means.

4. The apparatus of claim 1 wherein the arc of the forming die is approximately 100°.

5. The apparatus of claim 1 wherein ends of the upper lip of the curvature face of the forming die are elliptically shaped whereby the pipe to be bent can be directly inserted between the holding means and the forming die.

6. The apparatus of claim 1 wherein the holding means is provided with at least one curvature face having an arc of approximately 90° and means for adjusting the height of the said curvature face so that the neutral axis of the curvature face will lie in the same plane as the neutral axis of different diameter pipe and forming dies.

7. The apparatus of claim 6 wherein the holding means is provided with two curvature faces on opposite sides thereof with one face being closer to the bending block than the other curvature face whereby the curvature faces will hold different diameter pipes.

8. The apparatus of claim 1 wherein the means for keeping the pipe level with the curvature face of the forming die are riding pipes radiating out from the die at a height level with the bottom lip of the forming die curvature face.

9. The apparatus of claim 1 for bending pipes more than 90° wherein the holding means is provided with a laterally adjustable curvature face having an arc of approximately 90° and means for adjusting the height of the said curvature face so that the neutral axis of the curvature face will lie in the same plane as the neutral axis of different diameter pipe and forming dies.

10. The apparatus of claim 1 provided with means for clamping the pipe whereby the pipe is held in position to prevent twisting and turning of the pipe during compound bending.

11. The method of bending large pipes of at least 6" diameter which comprises heating the pipe to the bending temperature, anchoring one end of the pipe and bending the pipe in a horizontal plane the desired number of degrees around the curvature faces of a continuous arced forming die which at the bending point extends approximately 180° around the pipe circumference and the radius of the arc is equal to the radius of the bend to be made and is spaced from the bending floor.

12. The method of claim 11 in which the pipe being bent rests upon riding supports which support the pipe spaced from the bending floor substantially the same distance the bending die is spaced from said floor.

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2,604,924	7/1952	Blake et al.	72—386
3,368,377	2/1968	Hirayama et al.	72—342

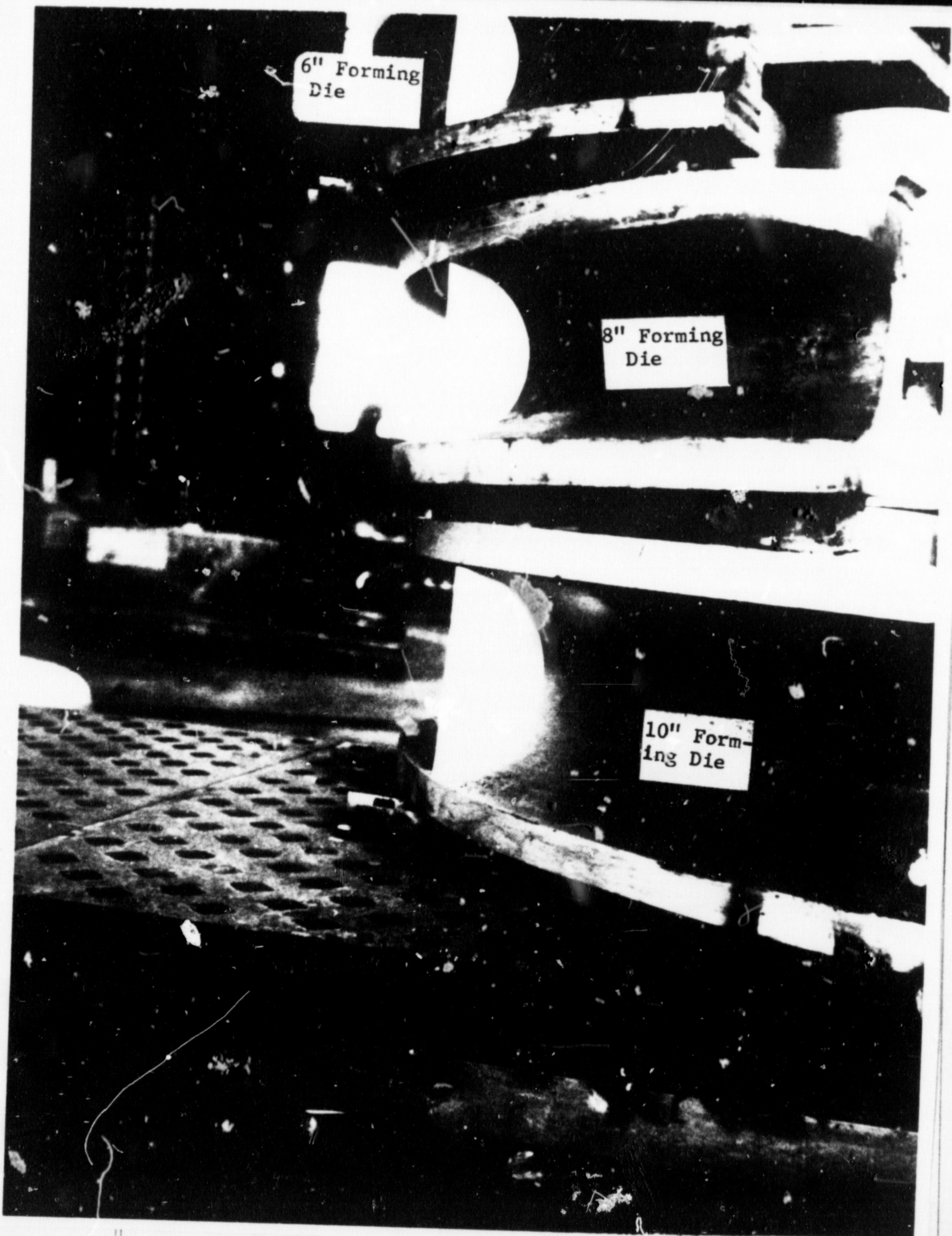
CHARLES W. LANHAM, Primary Examiner

LOWELL A. LARSON, Assistant Examiner

U.S. Cl. X.R.

72—342, 388

EXHIBIT 13



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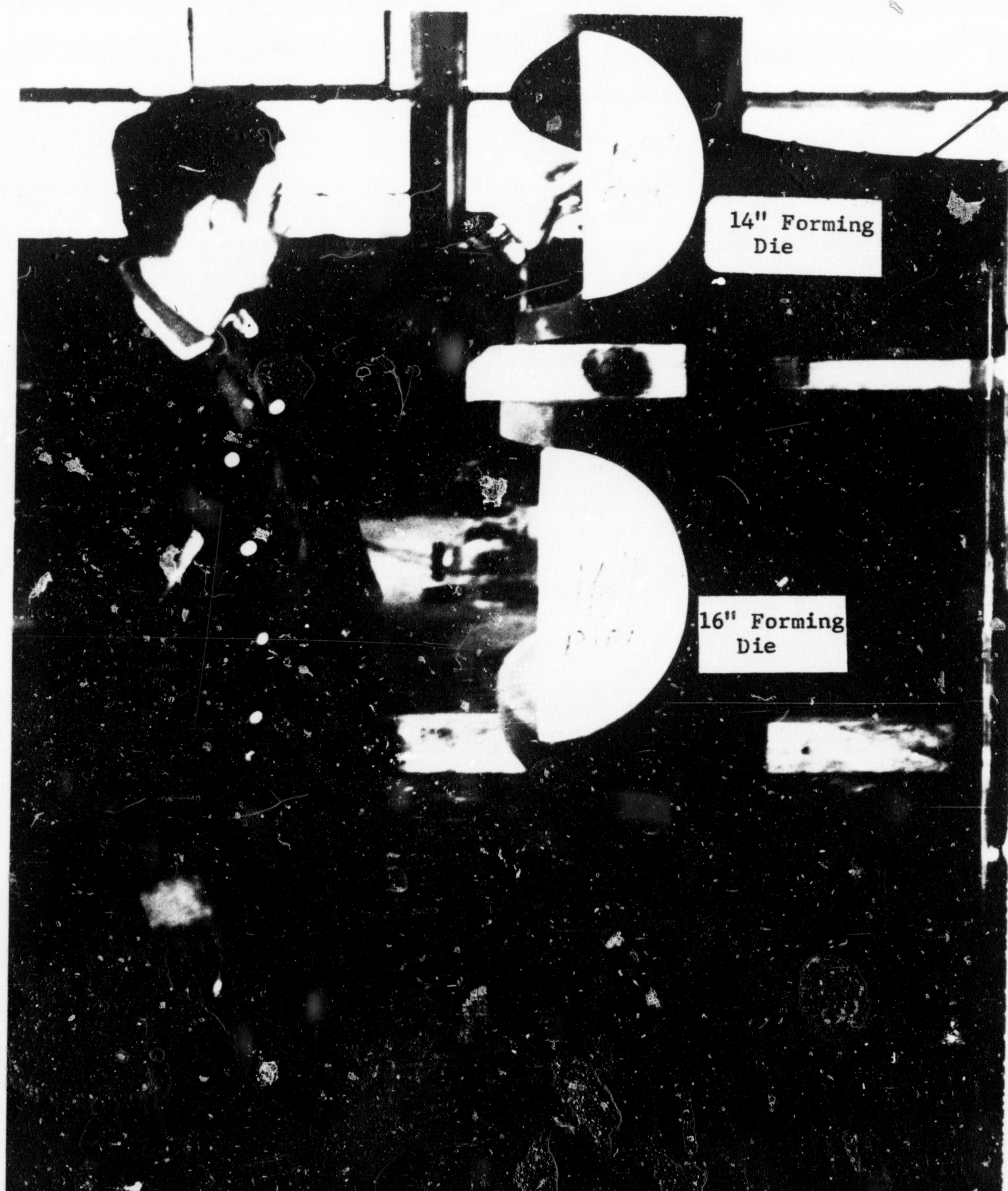
Crippen Supp. Afft.
Exhibit 13

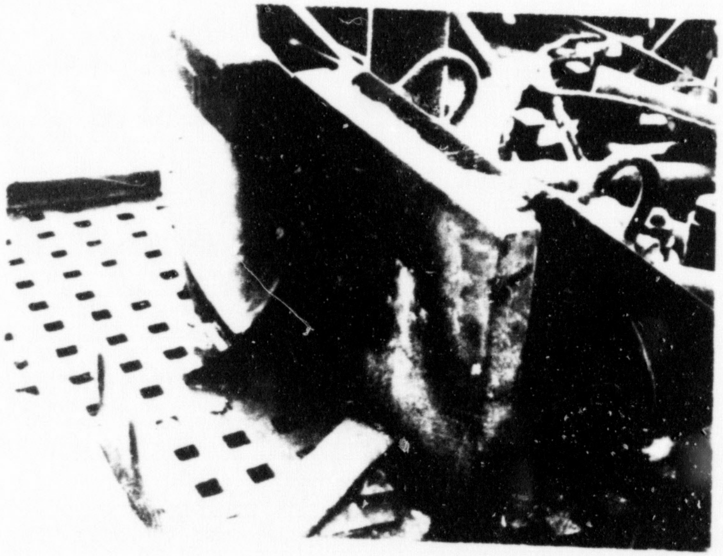
EXHIBIT 14



Crippen Supp. Afft.
Exhibit 14

EXHIBIT 15

PDX 36-3



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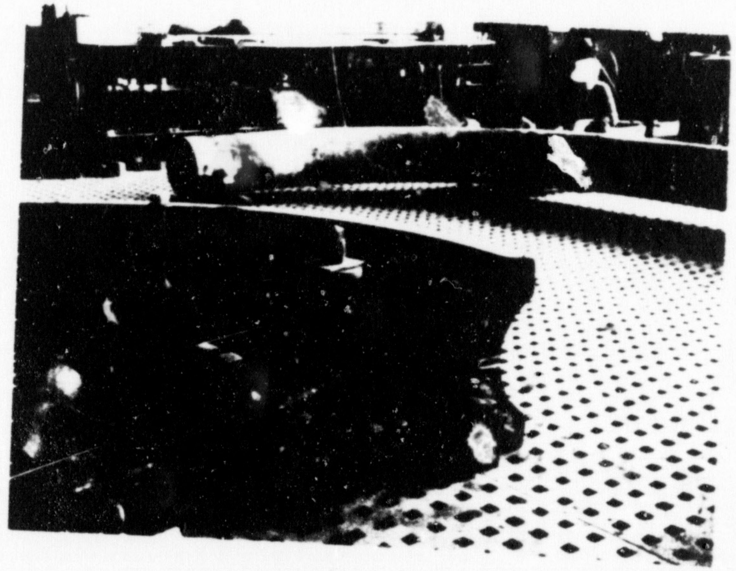
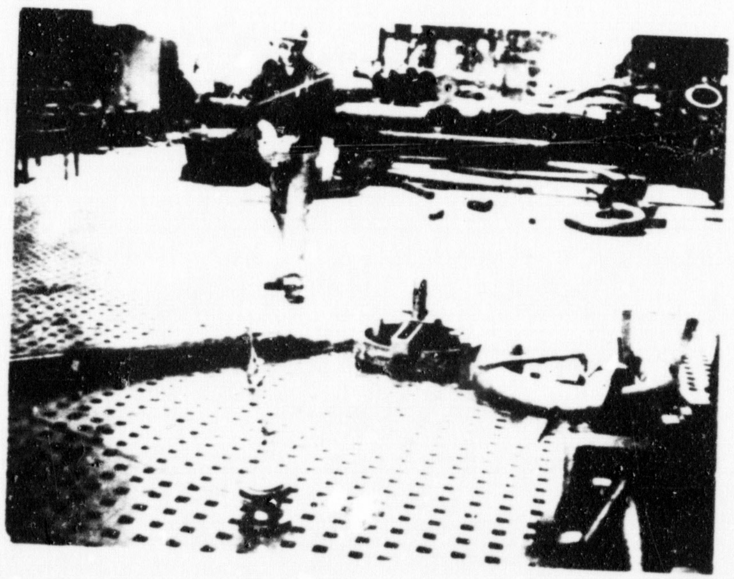
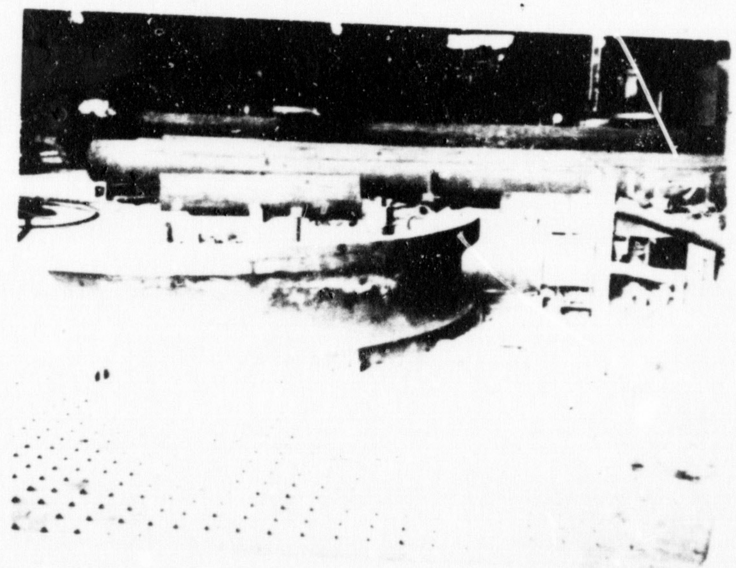


PDX 36-5





PDX 36-6

Crippen Supp. Aff.
Exhibit 15

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HOPGOOD

AFFIDAVIT OF PERSONAL SERVICE

STATE OF NEW YORK,
COUNTY OF RICHMOND ss.:

EDWARD BAILEY being duly sworn, deposes and says, that deponent is not a party to the action, is over 18 years of age and resides at 285 Richmond Avenue, Staten Island, N.Y. 10302. That on the 3 day of May, 1976 at No.345 Park Avenue, NYC deponent served the within Exhibits upon Morgan, Finnegan, Pine, Foley & Lee, Esqs. the Appellee herein, by delivering a true copy thereof to them personally. Deponent knew the person so served to be the person mentioned and described in said papers as the Appellee therein.

Sworn to before me,
this 3 day of May 1976

Edward Bailey

WILLIAM BAILEY
Notary Public, State of New York
No. 43-0132945
Qualified in Richmond County
Commission Expires March 30, ~~1973~~ 1977